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Thunderbolts and Eggshells

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Foreword

In 1975, Tactical Air Command (TAC) Comdr Gen Robert Dixon established the Red Flag Program. Red Flag sought to eliminate the so-called beginner syndrome by giving aircrews the kind of experiences they would see during the first ten missions of a war.[1] Although the program's principal purpose was to expose aircrews to a realistic threat environment, it had a twin goal no less important. For the first time ever, USAF airmen systematically trained during peacetime to employ large numbers of dissimilar aircraft in mutually supporting roles.

As the USAF continued to educate itself in this regard, something else happened. Airmen began to appreciate there was more to composite air operations than simply receiving tasking, meeting at a rendezvous point, and "making it all happen." Composite force effectiveness depended upon composite coordination like that practiced face-to-face at Red Flag. Yet, not only was the USAF's peacetime force structure largely monolithic, but key war plans also presumed monolithic operations. Something was missing.

Throughout the Air Force units began collaborating at the grass roots level to develop standards for composite force employment and abbreviated formats for telecoordination. Similarly, many tried to bring composite employment into their local flying programs, but expanded emphasis ultimately required leadership from the top down.[2]

This leadership came in the early 1980s. Flag exercises were significantly expanded and composite air operations became an increasingly "hot issue" in various commands. In the Pacific Air Forces (PACAF), for instance, then-Maj Gen Thomas McInerney, commander 313th Air Division at Kadena AB, Japan, initiated a series of Theater Large Force Employment Exercises (TLFE). These exercises eventually resulted in the development of a PACAF "playbook" that formalized command-wide procedures for coordinating composite air operations among dispersed monolithic organizations. In Central Command Air Forces (CENTAF), similar standards were developed and eventually integrated into the CENTAF subsection of Multi-Command Manual 3-1 and the Air Force Computer Aided Force Management Systems (CAFMS). CENTAF also followed up with a series of training exercises specifically designed to exercise telecoordination of composite air operations. Many commands followed suit.

Meanwhile, at USAF Headquarters, majors John Piazza, Dave Deptula, and Col John Warden were taking a different and more aggressive tack. They conducted a bottom-up review of USAF war-fighting requirements and advocated substantial revisions to USAF doctrine and force structure. "Air Legions" would be created to operate as air forces within the Air Force. These organizations would be task-organized and composite wings would play the leading role within each legion.

After several years of marketing these concepts, however, this vision died when the USAF deputy commander for operations called the three into his office and said: "You all need to drive a stake through the heart of this idea."[3]

Several years passed before support for the composite wing was resurrected again—this time, by then-Lt Gen Merrill McPeak publishing in the *Airpower Journal*.[4] Operation Desert Storm then saw the creation of an ad hoc composite wing at Incirlik AB, Turkey. Following the war, General McPeak, now Air Force Chief of Staff, inaugurated the first permanent composite wings since the Composite Air Strike Force of the 1950s.

At the heart of all these efforts has been a common sense of the criticality of composite air operations and the intrinsic strengths of the composite wing as an enabling organization. This thesis explores both themes in the context of Desert Storm. It reache two conclusions. First, the USAF's capacity to conduct composite air operations from a dispersed monolithic structure is both critical and in need of attention. Important deficiencies appeared during the war that can and should be corrected. Second, the composite wing is a strategic weapon. It can add power projection capabilities to our defense arsenal that are critically important and singularly unique.

For purposes of this thesis, monolithic and composite wings are defined as follows: Monolithic Wing—In a monolithic wing, logistical efficiency is the organizing principle for the collocation of a homogeneous force (i.e., one type of aircraft) under a single commander. Composite Wing—In a composite wing, the mission is the organizing principle for the collocation of a heterogeneous force (i.e., many types of aircraft) to facilitate composite mutual support. The composite wing also operates under a single commander.

Abstract

The lion's share of USAF aircraft in Operation Desert Storm was monolithically organized and geographically dispersed among numerous air bases throughout Saudi Arabia and other Gulf Cooperation Council (GCC) states. In Turkey, a composite wing was deployed to Incirlik AB. This thesis considers the relative merits of these organizations in the context of Desert Storm and implications for USAF doctrine and force structure.

On the face of it, such comparative analysis may seem futile. After all, if combat performance in Desert Storm is the yardstick then all organizations are winners. But USAF combat capabilities were by no means fully tested in this decidedly one-sided war. Thus, many of the most important lessons cannot be discerned in a tabulation of results, but only in consideration of (1) how efficiently they were achieved under the operative conditions, (2) how sensitive results were to adverse circumstances that might have developed but did not, and (3) how future adversaries might exploit USAF vulnerabilities.

Chapter 1 acquaints the reader with the concepts of composite mutual support, composite air operations, and composite and monolithic wings. Chapter 2 introduces the forces and organizations under study. Chapter 3 describes coordination requirements for composite air operations. Chapter 4 details coordination processes in monolithic and composite wings during Desert Storm. Chapter 5 considers relative strengths of composite wings—including synergy, responsiveness, adaptability, resiliency and agility. Chapter 6 explains advantages of monolithic wings that derive from logistical efficiency. Chapter 7 recounts the process that actually determined Desert Storm force structure.

The thesis then draws conclusions on the evidence of previous analysis. These include technical and training recommendations for improving composite air operations in a dispersed monolithic structure and observations concerning the strategic role of composite wings.

Author's Note

The author deployed from the 401st TFW, Torrejon AB, Spain, to assist with the reception of fighter forces at Incirlik AB, Turkey, during Desert Shield. During Desert Storm, he was an F-16 assistant operations officer and mission commander leading composite force packages against Iraq. Meanwhile, a sister squadron from the 401st TFW, the 614th TFS, conducted similar operations as a monolithic unit stationed at Doha, Qatar.[5] Thus, once the 401st TFW returned home, the author had common ground for conferring with mission commanders from the 614th TFS about the relative merits of monolithic and composite organizations from the vantage points of these two units.

Shortly after Desert Storm ended, the USAF Weapons School held a conference to assess lessons learned. The results were published in *Tactical Analysis Bulletin* (TAB) 91-2. This TAB echoed some "local findings" of the author and precipitated this thesis.

Research included a wide variety of sources, but several were essential. First, the author produced a written history of Proven Force immediately after the war.[6] Second, there was TAB 91-2. Third, the author conducted a survey targeting all squadron commanders, operations officers, and senior mission and package commanders that led or participated in composite air operations during the first ten days. For purposes of this thesis, this group and survey are referred to as the *Air Leadership Group* (ALG) and *Air Leadership Survey* (ALS). There were 47 respondents of 53 officers surveyed. Most provided significant written feedback. Many follow-up interviews were conducted.[7]

Fourth, all Desert Storm contingency reports on subject units were reviewed at the USAF Historical Research Institute. These documents provided unique insights on higher headquarters guidance, limitations of communications infrastructure, and the perceptions of aircrews flying at the time. Fifth, the *Gulf War Airpower Survey* (GWAPS) provided key background information on control processes. Sixth, the author conducted interviews with CENTAF headquarters personnel to balance operational and tactical perspectives.

Finally, it should be noted that the author does not claim any special expertise concerning the employment of all weapons systems discussed herein, nor does he pretend to have an integral view of the war if such a thing exists. It became obvious during the course of this research that where one stands depends on where one sits. Blind spots are inevitable. Nevertheless, the author hopes the resulting product is both balanced and useful to the USAF in preparing for future contingencies.

Chapter 1

Introduction to Composite Air Operations

Airpower is a thunderbolt, carried in an eggshell, invisibly tethered to a base.

—Hoffman Nickerson

The Evolution of Composite Mutual Support—Since the dawn of warfare, men have sought to leverage limited resources on the battlefield through mutual support between assets. The most rudimentary example is the advantage obtained by marshalling superior mass at a decisive point. Combat power can be multiplied further through specialization of forces and coordinated employment to achieve synergistic results. For example, reserves can exploit unforeseen opportunities or defend against unanticipated threats. Screening forces can allow for heightened mobility. Fixing forces can anchor the enemy to enable envelopment. These are examples of how functional specialization can leverage limited resources.

Functional specialization has progressed concurrently with developments in technology. Indeed, the relationship between the two has been symbiotic. New technology has suggested new functional applications. At the same time, functional roles have set parameters in the search for new technologies. This evolution has had several important consequences.

First, the development of different combat systems necessitated the introduction of distinct combat organizations. No one man could bear the complete complement of weapons that the technology of the time proffered. Therefore, specialized organizations were developed to exploit the unique advantages inherent in specific sets of technologies. As early as 1500 B.C., weapons, missions, and relative mobility began to dictate the composition of armies, and component organizations developed specialized doctrine, training, and logistical support.[8]

The second important consequence of this evolution was the requirement for doctrines for composite force employment. While technological specialization bestowed certain strengths upon a combat system, the price was peculiar weaknesses as well. Thus, commanders required theories that explained how to employ disparate systems in concert to multiply composite strength while compensating for weaknesses in various systems.[9]

The third, and related consequence of this evolution has been the role of lowest common denominators in restricting composite operations. When composite operations are prerequisite to employment, the weakest components can encumber the entire team. For instance, limitations on the

lethality, self-protection capability, endurance, or mobility of particular weapons systems can reduce the degree of freedom of an entire force when all systems must act together.

Fourth, it is important to consider the relationship between breakthrough technologies and composite operations. The advantages of a breakthrough technology have been sometimes so prodigious as to obviate the need for composite operations—particularly, when one belligerent possesses the new technology and the other does not. Such advantages have generally been short-lived, however, owing to the rapid proliferation of technology and/or the development of effective countermeasures. Thus, what begins as a breakthrough usually becomes integrated into a composite force as a matter of necessity.[10]

Fifth, it should be noted that beyond raw capabilities, the most fundamental requirement for composite mutual support is an effective control process. All other factors being equal, a decisive advantage accrues to the force that can coordinate its composite strength more effectively. Thus, composite mutual support puts a premium upon command, control, communications, and intelligence (C^3I) systems. Furthermore, it requires a doctrine for the organization and control of composite forces that takes full account of capabilities and limitations of both weapons and C^3I systems.[11,12]

To summarize, composite mutual support between disparate weapons systems has been a driving force in the development of combat technologies and war-fighting doctrines. This trend has been particularly profound in the race for the control and exploitation of the air.

The Ascendance of Composite Air Operations—Early in World War I, airmen began to recognize that combat power was not added, but multiplied, by mutual support between aircraft. A formation of two fighters was more powerful than two fighters employed singularly. A four-ship formation was more powerful still. Once again, this synergy represented more than the product of mass. Individual fighters performed specialized functions within their formations and even exchanged functional roles during air combat to achieve a relative advantage over their opponents.[13] During the Great War, however, such mutual support was limited primarily to similar fighter aircraft.

As World War II unfolded, it became increasingly clear that this potential for mutual support transcended both aircraft type and mission. No single airframe could bear the weight of the technological advances that multiplied combat power. The incorporation of particular design strengths begat peculiar weaknesses. Most obviously, bombers carried a great deal of ordnance, but were slower, less maneuverable, and hence more susceptible to destruction by enemy air forces than were pursuit aircraft. Pursuit aircraft carried little ordnance, but were well equipped to defend themselves and others. A composite force of bombers and pursuit allowed for the maximum exploitation of technology to achieve desired effects with minimum attrition. Indeed, with the introduction of the P-47 Thunderbolt and P-51 Mustang, composite air operations played a decisive role in 1944 by reopening the Combined Bomber Offensive (CBO) and forcing the contest for air superiority.

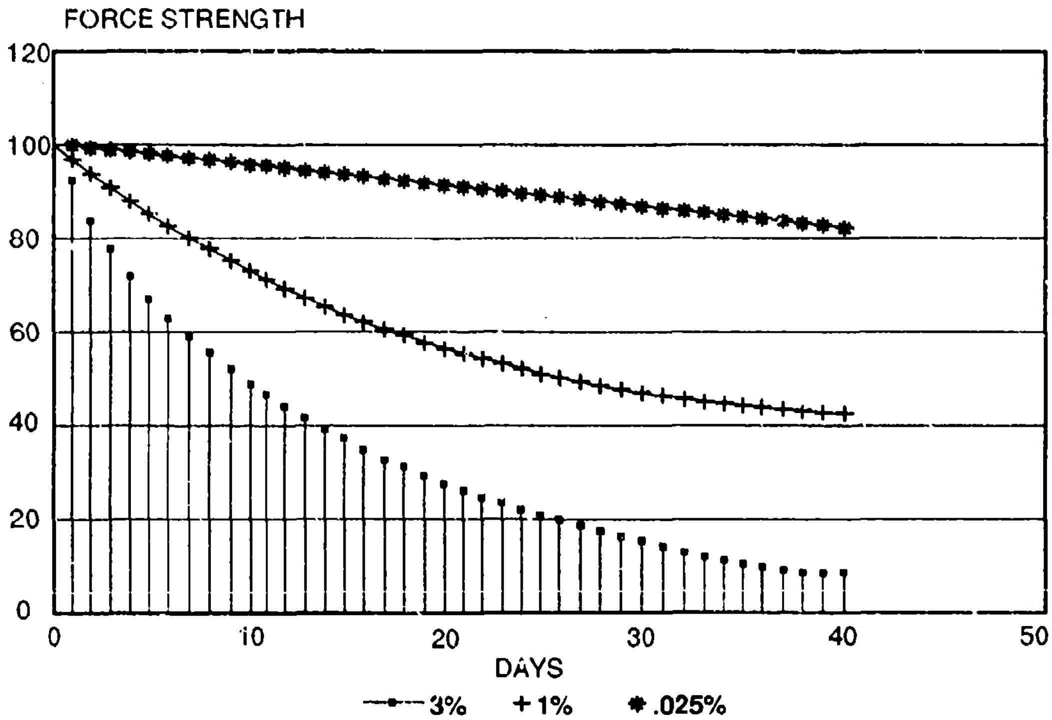
Nearly 50 years have elapsed since then, but this basic idea of the maximum exploitation of technology through composite force employment continues to exercise a strong influence on both USAF doctrine and force structure. Despite revolutionary advances in the capabilities of aircraft and munitions, technological constraints have continued to force the dispersal of capabilities among different aircraft. As a result, the USAF has become increasingly reliant upon composite mutual support as a linchpin of employment and a guiding light in the procurement process. This trend is evidenced by the dramatic proliferation of aircraft whose sole function is support of air-to-ground aircraft to enhance weapons delivery capabilities, or reduce attrition in the face of increasingly sophisticated threats. In other words, what began 50 years ago as an imperative for a simple fighter-bomber escort team has since produced a highly sophisticated web of relationships between multiple air and space systems.[14] The persistence of this trend is best explained in consideration of two factors: the fragility of air power, and the effects of attrition on total force strength over time.

In the words of Hoffman Nickerson, "Airpower is a thunderbolt, carried in an eggshell, invisibly tethered to a base." His metaphor is brought home in chart 1. It shows the impact of various attrition rates on total force strength at a rate of two sorties per aircraft per day. If attrition rates during Desert Storm had averaged one percent, for instance, 56 percent of total force strength would have been expended in 40 days. Had it averaged three percent, 92 percent would be expended in 40 days. What the chart conveys is that small variations in attrition rates have huge consequences in a relatively short period.

All military forces abhor attrition, but air forces are particularly inelastic in their ability to sustain high loss rates. This vulnerability has its origins in the nature of air power itself. First, aircraft and pilots are relatively irreplaceable at high combat tempos and this trend has accelerated over the last 40 years. Fighter production runs that were measured in weeks during World War II currently take a year or more, with little excess physical capacity or human compressibility.[15] Similarly, pilot training time has expanded from months to about two years before airmen are considered minimally qualified for combat.[16] Second, dramatic increases in the per unit costs of aircraft have exercised downward pressure on total force strength.[17] Third, as Desert Storm illustrates, advancements in the speed, range, survivability, and lethality of air power are extending the battlefield spatially, compressing it temporarily, and lending a relative advantage to offensive operations. Thus, the battle for air superiority may operate at much higher combat tempos than a ground campaign. Moreover, even a marginal loss in offensive momentum can quickly cascade into outright defeat because air forces once lost, cannot today be reconstituted in time to affect the outcome of the air battle or the war. All of these factors compound the problem of replaceability and drive home the adage that air battles are like poker—there is no place for a second best hand.

Chart 1

Impact of Attrition on Force Strength
(at two sorties per aircraft per day)



If the above chart demonstrates the imperatives of managing attrition, it conveys two other points as well. First, composite mutual support needs only to affect small reductions in attrition rate to retrieve what would otherwise be significant loss rates over time. Second, if composite mutual support can enhance weapons delivery capabilities so that fewer sorties are required to achieve desired effects, this may also produce substantial savings in total force strength.

Composite mutual support between disparate platforms has been a cost-effective determinant of force structure because it provides these types of leverage. The result has been an extremely well-balanced air force whose most distinctive characteristic is its versatility—its potential to configure itself to respond to a broad range of contingencies and rapidly adapt in a dynamic combat environment. This raw versatility is just that, however, a raw potential. Realization of this potential depends almost entirely upon an effective control process—in other words, a doctrine for the control of composite air operations that takes full account of capabilities and limitations of both aircraft and C^3I systems. This thesis considers one important dimension of this doctrine: the organization of air forces into both monolithic and composite wings. Once again, for purposes of analysis these organizations are defined as follows:

- Monolithic Wing—In a monolithic wing, logistical efficiency is the organizing principle for the collocation of a homogeneous force (i.e., one type of aircraft) under a single commander.
- Composite Wing—In a composite wing, the mission is the organizing principle for the collocation of a heterogeneous force (i.e., many types of aircraft) to facilitate composite mutual support. The composite wing also operates under a single commander.

Chapter 2

USAF Force Structure and Organization

Introduction—The lion's share of USAF aircraft participating in Operation Desert Storm was functionally organized by aircraft unit and geographically dispersed among numerous air bases throughout Saudi Arabia and other Gulf Cooperation Council (GCC) states. In Turkey, the situation was quite different. A composite wing moved to Incirlik AB. This chapter introduces the forces and organizations involved.

USAF Force Structure in the GCC—Figure 1 gives an approximate USAF air order of battle within the GCC on the first day of air combat operations, 17 January 1991.[18] The US commander in chief, Central Command (USCINCENT) had operational control (OPCON) of these forces exercised through his Joint Force Air Component Commander (JFACC). This thesis examines a subset of this force structure selected according to three criteria.

288 x F-16C	066 x B-52	012 x EF-111	007 x RC-135
192 x A-10	060 x OA-10	014 x EC-130	006 x TR-1A
072 x F-15E	008 x AC-130	011 x E-3B	200 x KC-135
066 x F-111F	144 x F-15C	002 x E-8	030 x KC-[illegible]
044 x F-117A	048 x F-4G	018 x RF-4C	

Figure 1. USAF Order of Battle in the GCC—Aproximate Number and Type of Combat Aircraft 17, January 1991

First, analysis is confined to those units that most frequently conducted composite air operations. Many units operated with relative autonomy. The 37th TFW, for instance, required little more than air refueling support owing to the stealthy characteristics of the F-117. Other units were excluded because the nature of their tasking significantly reduced support requirements over enemy territory. A-10s of the 354th TFW Provisional(P) at King Fahd, for instance, rarely received dedicated support because they were employed in an area where air-to-air and radar surface-to-air missile (SAM) threats were relatively subdued. Most USAF Guard and Reserve units also fall into this category. Second, joint and Coalition air operations are deliberately excluded to reduce the sample population and field of analysis to manageable proportions.[19]

Finally, the analysis is confined to the first ten days of the war. This is justified for two reasons. Composite mutual support began to lose its relevance after ten days as the Iraqi air defenses were either decimated or inactive. Additionally, this was the period in which USAF forces were under the greatest pressure. Therefore, to the extent there are weaknesses to uncover, they are most likely to manifest early in the war.

Figure 2 depicts those units in the GCC that routinely conducted composite air operations during the first ten days of Desert Storm.[20] For brevity, this group of dispersed monolithic organizations is referred to as the Southern Monolithic Structure (SMS). The reader should note that within this structure, not all wings were purely monolithic. The 4th TFW(P) at Al Kharj, for instance, has the appearance of a composite wing but never operated as such. Although disparate forces were collocated under a single commander, they were never employed in mutually supporting roles. The 48th TFW at Taif, on the other hand, was nominally composite. F-111, EF-111, and EC-130 aircraft operated under a single commander, and these aircraft were often employed in mutually supporting roles.[21]

• 1st TFW (Dhahran)	• 48 TFW (Taif)	• 388 TFW (Al Minhad)
27 TFS (24 x F-15C)	492 TFS (22 x F-111)	4 TFS (24 x F-16)
71 TFS (24 x F-15C)	493 TFS (22 x F-111)	421 TFS (24 x F-16)
• 4 TFW (Al Kharj)	494 TFS (22 x F-111)	69 TFS (24 x F-16)
335 TFS (24 x F-15E)	390 ECS (12 x EF-111)	• 35 TFW (Shaikh Isa)
336 TSF (24 x F-15E)	• 363 TFW (Al Dafra)	561 TFS (24 x F-4G)
53 TFS (24 x F-15C)	17 TFS (24 x F-16)	81 TFS (24 x F-4G)
• 33 TFW (Tabuk)	33 TFS (24 x F-16)	• 401 TFW (Doha)
58 TFS (24 x F-15)	10 TFS (24 x F-16)	614 TFS (24 x F-16)

Figure 2. The Southern Monolithic Structure (total of 438 aircraft)

Proven Force Structure—Figure 3 gives the Proven Force air order of battle at Incirlik AB. Proven Force meets the criteria of an ad hoc composite wing. The mission was the organizing principle for the collocation of heterogeneous forces to exploit opportunities for composite mutual support.

612 TFS (28 x F-16C)	804 ARW (15 x KC-135)
79 TFS (18 x F-111E)	552 TFS AWACW (3 x E-3B)
525 TFS (24 x F-15C)	43 ECS (3 x EC-130)
23 TFS (26 x F-4G/F-16C)	3 TFS (4 x F-4E)
42 ECS (6 x EF-111)	38 TFS (6 x RF-4C)

Figure 3. Proven Force Combat Aircraft (total of 133 aircraft)

Command relationships between Proven Force and Riyadh were somewhat unique. United States commander in chief, European Command (USCINCEUR) retained OPCON of Proven Force to provide for the defense of Turkey. The Proven Force commander, Major General Jamerson, was given tactical control (TACON). Both supported USCINCENT through his JFACC.

Chapter 3

Coordination Requirements for Composite Air Operations

The Master Attack Plan—The purpose of the Master Attack Plan (MAP) during Desert Storm was to "operationalize" air strategy. The MAP translated strategic objectives into targeting priorities and allocated aircraft and munitions in accordance with those priorities over time. In broader terms, the MAP distributed the weight of the air combat effort against critical enemy centers of gravity in accordance with shifting priorities on a theater-wide basis. Building the MAP was a continuous process, but cycle-time between final revisions generally ran between 24 to 33 hours to support development of an Air Tasking Order (ATO).[22]

The Air Tasking Order (ATO)—The primary vehicle for technical control of forces during Desert Storm was the ATO. The ATO was administered the employment of aircraft in time, space, and purpose on a mission-by-mission basis. Its aim was the efficient use of air assets to achieve desired effects with minimum attrition. ATOs typically ran about 300 pages.[23] Production time varied. The primary system intended for ATO distribution was a computer network called the USAF Computer-Aided Force Management System (CAFMS). Secure telecommunications and a tactical courier system provided backups.

The ATO and Composite Air Operations—Despite its excessive length, the ATO did little more than set broad parameters for the execution of composite air operations. Within these parameters, extensive intraunit coordination was usually required to realize effective composite mutual support. These coordination requirements are best illustrated by means of a representative example. Suppose the ATO tasks certain assets with the destruction of enemy command and control facilities defended by antiaircraft artillery (AAA), SAM systems, and possibly enemy fighters. The ATO provides the following information:

Mission Data

Target: Baghdad C^3I Facilities
Time: 1200–1220Z
Assets and Mission
24 x F-16* — destroy specified targets (ATTACK)
08 x F-15 — offensive counterair (ESCORT)
04 x F-4G — suppression of enemy air defenses (SEAD)
04 x F-16 — suppression of enemy air defenses (SEAD)
02 x EF-111 — close-in-jamming (CIJ)
02 x EF-111 — stand-off-jamming (SOJ)
01 x EC-130 — communications jamming
04 x RF-4C — tactical reconnaissance
08 x KC-135 — air-to-air refueling (AAR)
01 x E-3A — airborne warning and control system (AWACS)
04 x F-15 — defensive counterair (DCA)
* Mission Commander

It specifies the time and place where attackers will strike the objective, supporting assets, a mission commander, and other generic data such as deconfliction requirements, identification of friend or foe (IFF), rules of engagement (ROE), and so on.

Given sufficient time, the F-16 mission commander in the above example might coordinate with up to eight package commanders to facilitate composite mutual support. Some of this coordination can be accomplished in flight, but most must be done on the ground. A sampling of coordination requirements in two missions support areas, suppression of enemy air defenses (SEAD) and offensive counterair (ESCORT/SWEEP), suggests the complexity of the problem.

SEAD Coordination Requirements—It is insufficient that the SEAD package just show up near the target area and suppress SAMS in the area from 1200–1220Z. First, consider the question of timing. It is quite possible the ATTACK package will be in and out of the target area in less than five minutes. If this is the case, SEAD aircraft will incur unnecessary risks staying there for the full twenty. Second, they more likely will lack endurance to remain the entire period. Third, timing adjustments may be required in flight. Consider what can happen if either the ATTACK or SEAD package is unavoidably delayed—say beyond a precoordinated five minute span for the raid. If the ATTACK package is delayed and this information is not passed, SEAD aircraft might expose themselves unnecessarily for five minutes followed by entry of the ATTACK package into a high threat area without SEAD support.

The problem of timing is basic, but effective SEAD requires much more. Wild Weasel suppression, in particular, can be significantly enhanced by coordinating of specific objectives and procedures.[24] For instance, certain

SAM systems in the target area may be irrelevant to the attack package by virtue of the tactics employed. Others may be irrelevant because of their location. If Wild Weasels know precisely which threats count and which do not, they will not be distracted by irrelevant defenses; they will not expend ordnance unnecessarily; and they can provide real-time information on the status of potentially lethal systems both in the target area and en route.

To cite another example, effective employment of EF-111 CIJ aircraft is similarly coordination intensive. CIJ effectiveness is heavily dependent upon the spatial relationship between the EF-111, the threat, and the aircraft the EF-111 is protecting. In the final analysis then, what is required to integrate SEAD forces is a meeting of minds concerning the ATTACK flow plan. SEAD aircrews should know the ATTACK route, timing along the route, altitudes, tactics that will be employed, the communications plan, and so on—so that they can develop a game plan that effectively supports mission objectives.

ESCORT/SWEEP Coordination—Effective integration of the ESCORT/SWEEP package is also relatively complex. First, coordination of radar search plans between F-16s and F-15s is preferable so they are mutually reinforcing vice duplicative, or a source of interference. Second, an effective detection, sorting, and targeting process may require precoordination with ESCORT/SWEEP aircraft, AWACS, and all other mission aircraft concerning the type of radar control, commit criteria, and rules of engagement. Third, the process of identifying friend or foe can be greatly simplified by mission procedures. Fourth, actual ESCORT/SWEEP effectiveness in flight will depend largely upon the spatial relationship between the ATTACK package, ESCORT/SWEEP aircraft, and airborne threats. Thus, the ESCORT/SWEEP flow plan should anticipate and compensate for areas where the attack package is particularly vulnerable. The threat of enemy fighters from an air base near the target area, for instance, might dictate the formation of a barrier combat air patrol (CAP) throughout the period of the attack.

Thus, just as with SEAD, effective integration of ESCORT/SWEEP aircraft requires that the counterair game plan be built around the ATTACK flow plan for maximum support of mission objectives. Ultimately, all three flow plans (ATTACK, SEAD, and ESCORT/SWEEP) should be mutually reinforcing and comprehended by all participants. If not, every unidentified image, either radar or visual, becomes a potential air threat. The mission impact may be as minor as a route deviation or as critical as a blue-on-blue live-fire engagement. Integration of flow plans greatly improves each pilot's ability to assess whether unidentified aircraft are friends or foes.

Coordination for Contingencies—All this said, coordinating primary flow plans for ATTACK, SEAD, and ESCORT/SWEEP packages may still be insufficient to assure success. More often than not, all participants must master a set of related flow plans. For example, a weather backup plan may differ radically from the primary plan and dictate a different flow. A reattack option may be viable and dictate yet another flow plan. Without a good understanding of contingency plans and a way to direct transition, mutual support between assets will be lost.

Coordination for Communication—Finally, a communications plan is critical to effective employment of SEAD and ESCORT/SWEEP aircraft. The ATO specifies radio frequency assignments, but little else. Such questions as who monitors what frequencies; who talks on the radios; and when, how, and why, may be highly mission-dependent. To the extent that mission flow plans and objectives are precoordinated, communications requirements will be greatly reduced. Under optimal circumstances, use of the radios will be reserved primarily for prosecution of threats or other contingencies. On the other hand, if precoordination is minimal, the entire mission can become a contingency and extensive in-flight communication may be required for integrated employment. This may saturate radio frequencies to such an extent that they are unusable and coordinated employment must be forborne. The bottom line is this: the greater the precoordination, the less the need for in-flight communications to conduct the mission—and, the greater the ability to adapt to unforeseen contingencies using the radios.

To summarize, the ATO does little more than set broad parameters within which substantial coordination may be required for effective composite air operations. This chapter has merely sampled some typical coordination requirements. Many more may exist. The next chapter examines this sample in the context of coordination processes in the SMS and Proven Force during Desert Storm.

Chapter 4

Coordination Processes During Desert Storm

Proven Force Coordination Processes—Proven Force coordination worked something like this. The mission commander received tasking via the ATO, determined assigned forces, did a threat assessment, and developed an ATTACK game plan. Next, he sought the advice of his package commanders. Together they adjusted the ATTACK game plan and developed support plans that were mutually reinforcing. Package commanders then returned to their units to flush out support plans in detail. Meanwhile, the mission commander finalized ATTACK plans and determined all other mission coordination requirements. Finally, a few hours before takeoff, mission participants gathered in a single room where two things happened.

First, master maps and mission coordination cards were distributed. The master map was a color depiction of mission flow plans. The coordination card summarized all mission-relevant information (that could be expressed in alphanumeric form) on a sheet of paper small enough to fit on a pilot's kneeboard. Together, the master map and mission coordination card served essentially the same purpose as the ATO, only at the tactical level. They summarized mission parameters required for coordinating air power in time, space, and purpose to achieve mission objectives.[25]

Second, the mission commander briefed all participants on the proper conduct of the mission and probable contingencies and responses. During the course of this briefing, package commanders came forward to brief support plans in context. The primary focus of the briefing was to assure that those flying the mission could conceptualize the plan, since all mission data had been previously distributed. The result was that all participants understood objectives, their role in the plan to achieve them during each phase of the mission, and everybody was reading from identical sheets of music.

Coordination Processes in the SMS—Coordination requirements in the SMS were identical in character to those in Proven Force. The key difference was that most SMS coordination occurred by telephonic instructions known as Mission Coordination Orders (MCO).

The single exception concerned planning for the first two days of the war. In this case, key mission and package commanders attended several planning conferences over the course of four months—essentially creating a massive composite wing to plan the first two days. Coordination was further enhanced by numerous academic exchanges between units to refine support

requirements for these preplanned missions. CENTAF provided the following guidance concerning coordination of composite air operations after the first two days:

> Four methods of distributing mission coordination orders (MCO) are currently available—(1) Simultaneous transmission to all units concerned can be accomplished by message, but experience has shown that MCOs sent by message are too late to be of value; (2) Telephonic briefs ensure contact with receiving units as well as providing immediate feedback, but this method is very time consuming for the mission commander who may need to call as many as six other units; (3) Telefax hardcopy also ensures contact with units, but also is time consuming and may not reach units in time to mission plan; (4) The remaining method is CAFMS MCOs, which allow simultaneous transmission to the benefit of the sender, and is not delayed in a message center, which should allow the receiving unit to plan.[26]

The first two days of the war were executed according to plan. On subsequent days, however, there were significant breakdowns in coordination owing to limitations of these communications systems.

CAFMS Limitations—The *Air Leadership Group* (ALG) was quite critical of CAFMS as a mechanism for disseminating the ATO.[27] The principal critiques were (1) transmission was slow; (2) breakdowns were too frequent; (3) the system was not user friendly; and (4) these limitations were exacerbated by a lack of training. In retrospect, evidence supporting the first critique was compelling but inconclusive. It is impossible to assess the extent to which delays in ATO transmission are explained by delays in ATO production and inputting, internal CAFMS limitations, or user training problems.

The latter three problem areas are well supported by both the *Air Leadership Survey* (ALS) and TAB 91-2. Numerous breakdowns in CAFMS transmission did occur and courier operations were often critical to mission accomplishment. Training was also a big problem. Very few airmen had ever seen CAFMS before and it was anything but user friendly.[28] Depending upon how an ATO was printed, for instance, it could run anywhere from 300 to 1,000 pages with a corresponding print time of 30 minutes to well over an hour. It would then take another 45 minutes to read and "break out" those portions of the ATO relevant to the unit mission. On the other hand, someone thoroughly trained on CAFMS could print only those parts of the ATO that were relevant and time-critical.

Interunit coordination through CAFMS MCOs was rare. The ALG reported that CAFMS was basically dysfunctional for distribution of MCOs.[29] In most cases, mission commanders said they had insufficient time to make inputs and expect timely transmission. On the other hand, even if sufficient time did exist, they preferred telephonic coordination for three reasons. First, it was judged as faster than CAFMS.[30] Second, it provided for transmission of both data and conceptual information. Third, there was positive confirmation of receipt.[31] In spite of these advantages, telecoordination presented its own unique problems.

Telephonic Limitations—Telephonic systems imposed significant constraints on both the quantity and quality of interunit coordination during

Desert Storm. Mundane as they are, these constraints are worth examining in contrast to the face-to-face coordination process in the composite wing.

First, there are the familiar problems associated with reaching someone by phone. The lines are busy. The person cannot be found.[32] If a message is left and the call is subsequently returned, the original caller is not available. When the connection is finally made, it is interrupted—ad nauseam. Second, in the absence of a conference call, the mission commander must deal with package commanders in serial order. Third, without a facsimile machine (FAX), telephonic transmission of information is likewise serial.[33] If a package commander requires a copy of the ATTACK flight plan, for instance, the mission commander cannot hand him one. Someone must transmit the information digit-by-digit by word-of-mouth. Fourth, data transmission errors will be prevalent for obvious reasons. Alphanumeric information may be misread, misunderstood, or garbled by third parties. Concepts may be misunderstood because the sender and receiver do not have the benefit of visual aids (i.e., a map). Fifth, there is little or no quality control in this process such as that provided by a master map and mission coordination card. Finally, the reliability of secure telecommunications is often an obstacle.[34]

All of these factors diminished the quantity and quality of information that could be transmitted. As Desert Storm entered day three, intraunit coordination became muddled. As one mission commander put it, "When the lines were not busy, the man with the plan could not be found." The overall impact on composite operations was well characterized in an aircrew interviewed by an Air Force historian on location. "I felt real good after our first three missions. Of course we had planned them for four months, so we knew where everybody was going to be . . . but then the packages got real tangled and there was a lot of confusion on where the other players were."[35]

Different units handled these problems in different ways. A few units conducted operations for the first ten days with almost no premission coordination.[36] Other units were more aggressive and nearly always connected with companion units. Those who were most successful excluded the mission commander from the planning and coordination process almost entirely. They used dedicated mission planning cells working through the day or night to effect the coordination required for upcoming missions.[37] In spite of these efforts, however, impediments to communication had measurable consequences in flight.

Chapter 5

Relative Advantages of the Composite Wing

Introduction—The principal advantage of the composite wing seems simple enough—the opportunity for face-to-face coordination among aircrew members who fly in mutually supporting roles. In reality, advantages are much more far-reaching. Like money in the bank which can purchase a great many things, this capacity for coordination has a broad range of derivative benefits that exist apart from, but are dependent upon, an efficient coordination process. These are roughly characterized in terms of five measures of merit: (1) synergy; (2) responsiveness; (3) adaptability; (4) resiliency; and (5) agility. This chapter explains these measures and assesses the relative capabilities within Proven Force and the SMS on the basis of each. It concludes by examining real and potential implications for combat effectiveness.

Synergy

What is Synergy?—Every operational objective necessitates formation of a network of supporting objectives extending down to the tactical level. Ideally, this process continues until every man is imbued with the subobjectives that apply to him and knows how they relate to the overall mission. When the test comes, operational effectiveness depends not only on the efficacy of this network of objectives, but upon the level of definition, or specificity, with which aims are transmitted. Once again, if SEAD pilots know their objective is to suppress particular SAM systems, at a particular time, to support a particular group of aircraft, they may be much more effective than they would suppressing all SAMs in the vicinity of Baghdad sometime between 1200–1220Z. They may also reduce risk to themselves.

Such is the case with a virtual encyclopedia of mission-specific objectives that are neither defined nor conceived at the operational level. The ATO cannot possibly cut this deep, nor should it try. When composite mutual support is critical to success, pilot-to-pilot coordination must underpin the solution. The goal of this coordination process is synergy—in other words, leverage born of composite mutual support that can heighten the probability of achieving desired effects with minimum attrition.

Synergy in the SMS—The mission commander was responsible for achieving this synergy during Desert Storm. Theoretically, he had

responsibility for the quality of composite mutual support and in-flight operational control of aircraft tasked to support the mission. In the SMS, however, it was quite difficult for mission commanders to play this role. They often did not plan or coordinate the missions they led. What contact they had with forces under their control was generally little more than a disembodied voice transmitting highly abbreviated instructions over the telephone or UHF radio. Under such circumstances, they were hardly accountable for assuring unity of effort. Neither were forces under their control accountable for implementing the plan as the mission commander conceived it. Thus, while there was unity of effort at the theater level administered by the ATO, and unity of effort at the flight leader and package commander level resulting from unit leadership, the leadership chain was often disrupted at the mission commander level. This resulted in breakdowns in the transmission of objectives and a corresponding reduction in the quality of composite mutual support.

Synergy in Proven Force—In the 7440th CCW (P), the opposite was the case. The mission commander was fully accountable for the effective employment of all forces, and these forces were likewise accountable to him for correctly executing the plan. This relationship was made possible as a result of face-to-face planning and mass briefings and debriefings. It allowed the mission commander to (1) inculcate a sense of mission priorities, (2) provide a conceptual framework for the mission, (3) disseminate specific parameters for composite mutual support, and (4) establish a leader-follower relationship with the forces under his control. As a result, he could employ his forces with the confidence that all participants knew what they were doing—and, that he had unambiguous control over them. In sum, leadership was ascendant at the mission commander level—as well as at higher and lower levels—and the result was synergy.

Measuring Synergy

Failures of Precoordination—The *Air Leadership Survey* (ALS) provides compelling evidence of the disruption of composite mutual support in the SMS. This disruption began with failures to coordinate routine mission parameters on the ground. Thirty-eight percent of the ALG described the telecoordination process as "very difficult," 45 percent as "moderately difficult," and 17 percent as "not too difficult," during the first ten days. The vast majority of responses indicated that coordination was highly abbreviated. The data given below portrays success rates in precoordinating a sample of 12 routine mission parameters throughout the ALG. Coordination of these and a host of other parameters was standard on all Proven Force missions.

- 74%—Precoordinated ATTACK groundtrack.
- 66%—Precoordinated SEAD groundtrack.
- 63%—Precoordinated ESCORT/SWEEP groundtrack.

- 77%—Precoordinated push point (rendezvous point) and time.
- 78%—Precoordinated planned time-on-target.
- 69%—Precoordinated target area flow plans.
- 48%—Precoordinated a weather backup target and alternate routing.
- 53%—Precoordinated so SEAD game plan accounted for specific vulnerabilities.
- 61%—Precoordinated so ESCORT/SWEEP game plan accounted for specific vulnerabilities.
- 53%—Precoordinated communications plan that permitted SEAD aircraft to furnish real-time information on the status and location of relevant SAMS.
- 58%—Precoordinated communications plan that permitted ESCORT/ SWEEP aircraft to share real-time information on the status and location of relevant air-to-air threats.
- 67%—Precoordinated mission specific procedures to either aid in the identification of friend or foe and/or to ensure flight-path deconfliction.

As these data indicate, there were significant shortfalls in precoordination within the SMS. Furthermore, quality of coordination suffered. The following mission commander comment was typical: "To get the plan out quickly, I used the first two days as reference points. I would say, 'Do you remember Day Two AM? Do this (mission) kind of the same, but use these coordinates'."

The ALS also revealed that precoordination problems were exacerbated by the relative scarcity of support aircraft in relation to those for ATTACK. The Desert Storm air campaign put a premium upon simultaneity and hig' combat tempos. This, in turn, required that scarce support aircraft often service two or more ATTACK packages during the same mission. F-15 aircraft supported more than one ATTACK package about 40 percent of the time, F-4Gs about 60 percent, and EF-111s about 40 percent during the first ten days.

When support aircraft serviced two or more ATTACK packages, they could either coordinate specific mission parameters to optimize coverage for in detail—or, they could revert to a less effective "area coverage" approach based upon target parameters published in the ATO.[38] Support package commanders reported defaulting to an area coverage approach nearly half the time owing to the difficulties of precoordinating with multiple packages.[39] Proven Force operations were optimized in detail. When ATTACKERS were divided to strike multiple target areas, mission commanders retained centralized control to optimize the use of limited support aircraft via adjustments in timing, routes of flight, and through the use of refueling assets.

Measuring Degradation in Composite Mutual Support—Many failures of precoordination could not be redressed in flight. Overall, the ALG reported that failures in precoordination had a deleterious impact on about 26 percent of all missions flown during the first ten days. Of this 26 percent, composite mutual support was described as *significantly degraded* owing to failures of precoordination 12 percent of the time.[40] On the remaining 14 percent, failures to precoordinate were said to have *precluded* composite

mutual support.[41] Many noted that their estimates were probably conservative. Emphasis on minimum communications reduced situational awareness. As one operations officer put it, "We didn't talk too much—EMCON (emissions control)—so I can only tell you about those missions where consequences were obvious."

Consequences varied depending upon the type of support. Coordination with SEAD aircrews was particularly important because of limitations peculiar to these weapons systems themselves, scarcity of assets, and because most Iraqi centers of gravity were heavily defended by SAMs. In the case of the F-4G, limitations on range and endurance necessitated precise coordination with ATTACK and ESCORT aircraft to provide coverage before fuel requirements dictated a return-to-base. EF-111 aircraft had substantial range and endurance, but their jamming envelope necessitated precise coordination.[42] ESCORT assets, on the other hand, were much more plentiful and flexible in adapting in the air and this was evidenced in the survey results.

The ALS also unearthed a wide variety of other coordination problems that degraded composite mutual support. In the area of communications, for instance, the ALG reported that excessive in-flight coordination requirements resulted in saturation of communications about 10 percent of the time. On the other side of the coin, not everybody always made it to the right frequency on an additional 12 percent of all missions. Both types of communications difficulties caused multiple second-order problems. Several mission commanders said they frequently had no contact of any kind (radio, radar, or visual) until forces entered enemy territory. As a result, "go no-go" decisions based on the fall-out of support assets were often moot. Similarly, several incidents of nonunamimous weather aborts, reattacks, or transitions to weather back-up targets were reported owing to problems of communication.[43]

Identification of friend or foe (IFF) and airspace deconfliction were also complicated by failures of precoordination. The ALG reported serious flight-path deconfliction problems in enemy territory on 8 percent of missions in the first ten days.[44] Failures to precoordinate target area flow plans also resulted in IFF problems about 16 percent of the time and numerous intercepts for visual identification of friendly aircraft.[45] In a few cases, an air-to-air engagement against a friendly aircraft was narrowly avoided.[46]

To summarize, the quality of mutual support in the SMS was often degraded because telecommunication systems often proscribed effective coordination for composite mutual support. What coordination did occur was usually abbre- viated. Most gaps were "handled" in flight, but there was substantial fog and friction, and significant breakdowns were fairly routine. It is difficult to appreciate these breakdowns and their consequences by simply reading summary survey results. The following is a short excerpt from a squadron commander narrative that shows some typical problems encountered by mission commanders. The remarks are particularly poignant because of the uncertainties expressed about where mission coordination was supposed to occur.

- We had for three months voiced the opinion that we needed a strong battle manager in AWACS or at least someone who would put their coffee down and make or coordinate a decision. We were assured by {name deleted} that this would happen.
- AWACS never offered (and was never able to confirm if asked) tanker call sign, track, or even if they were i. the track. A couple of times we proceeded to tracks to find two to three tankers (instead of five). Once we almost lost eight jets for lack of fuel.
- No one in AWACS could give the status of mission assets. We were dealing with 60 plus aircraft, up to six different types and roles, six different tanker tracks separated by 200–300 miles. AWACS couldn't give a (time-of-day to synchronize Have Quick radio systems). They didn't know who was airborne or on time for the mission. So you pushed and didn't find out who or how many there were until the push point/border [too late for anything but cancel]. So the decision tree of will you go with four F-4Gs (versus 8 F-4Gs) or 4 F-15s (versus 8/12) happened too late, and often you weren't sure how many you had. There you were in the dark, with weather, with 18 aircraft, one tanker, trying to run through freqs, use (secure voice transmission systems) and so forth, to coordinate with your assets most of whom were too far away or not on freq.
- The ACE wouldn't make weather abort calls even if he was told we weren't going to accomplish anything. But being a dumb fighter pilot I assumed we were serving a real objective by dropping through the weather.
- Let me give another example. Third day. Mission was to takeoff two hours prior to sunrise, hit airfield West of Baghdad, 40 F-16s and 28 support assets, single track cell for F-16s, ingress, TOT, egress, poststrike AAR, RTB. Mission changed two hours prior to takeoff to SCUD site near Syria. Some coordination done (not all). Weather in tanker track. Tankers not at rendezvous. Thrash around and finally find some tankers somewhere (again, no help from AWACS). Burn lots of brain bites. No words from F-15s, but EFs push in front as planned anyway (lots of guts but they were nervous). [Meanwhile] F-15s are at their orbit point 150 miles deep in Iraq—waiting! We should do better than that.

Responsiveness

What is Responsiveness?—In general systems theory, responsiveness is a measure of the effectiveness of a system in adapting to changes in the external environment. In the present context, this measure has a similar meaning defined by the desired versus actual operational reaction time for conducting composite air operations. Using this definition, a lack of responsiveness during Desert Storm might be manifested in one of two ways: (1) either the system was unresponsive in that rapid changes in operational

tasking led to a breakdown of composite mutual support, or (2) the system was unresponsive in that desired changes were forborne by command authorities to preclude such a breakdown. In either case, the idea is to determine if and to what extent the time required to secure composite mutual support was a limiting factor in the responsive conduct of the war.

Command Restraint—The air strategists that developed the MAP and the staff that published the ATO were acutely aware of the limitations of their highly centralized control process. A significant change in one portion of the MAP or ATO would have cascading consequences that reverberated like a pebble disturbing the surface of a glassy lake.[47] This awareness, however, did not appear to generate much restraint once the war began.[48] The first two days of combat operations were conducted with the confidence that occurs from four months of preparation including several face-to-face planning conferences and academic exchanges.[49] During the subsequent eight days, however, ATO distribution was not timely. As one squadron commander described it, "By day three, the ATO was basically a historical document that described what we were supposed to do after we had already done it. Virtually all of our tasking was received by phone and changes were the rule." Most support package commanders were less severe in their critique because their coordination requirements were more modest than those of mission commanders. As a group, the ALG reported that tasking changed about 35 percent of the time after the ATO had been received during the first ten days.[50]

The airspace management plan was a different story. This was the portion of the ATO that prescribed such things as refueling tracks, entry and exit points to and from enemy airspace, the communications plan, and a wide variety of other procedures. The plan changed little during the first ten days for three reasons.[51] First, the volume of aircraft in restricted airspace was so dense there were only so many ways to tackle the problem. Second, basing, platform capabilities, and fuel requirements dictated a certain degree of repetitiveness in tasking. Third, airspace management was a monumental task. Aircraft volume pressed deconfliction requirements to the limit and there seemed little point in "fixing" something that was not broken. Nonetheless, it is notable that 70 percent of the ALG considered their repetitive routes and profiles to be an important vulnerability that a more competent enemy might have exploited.[52]

Responsiveness in the SMS—Rapid changes in tasking had numerous consequences for interunit coordination in the SMS, but two were most important. First, telecoordinating the ATO (and recoordination of missions) increased demands upon the communications infrastructure. There were clearly peak periods where jammed phone lines made it extremely tedious or impossible to telecoordinate. Second, and more importantly, changes reduced the time available for coordination prior to mission execution. Such changes were not debilitating, but there is strong evidence of a correlation between rapid changes in operational tasking and breakdowns in composite mutual support.

Overall, the ALG reported that changes produced requirements for recoordination about 40 percent of the time.[53] Moreover, late mission changes were held accountable for about 20 percent (of the 26 percent) of all sorties where composite mutual support was reported as degraded or nonexistent. Many in the ALG described some fascinating anecdotes concerning attempts to handle mission changes in the air. Some examples include (1) 30-second mission briefs on tankers; (2) never finding support aircraft or discovering they were executing "the old mission"; (3) "bootlegging" support in flight; and (4) finding out that the mission just flown had been "cancelled." One mission commander even described how his ATTACK package tasking was "cut in half" on takeoff and the subsequent processs of "negotiating for support aircraft" while crossing the border on his new mission.

Other anecdotes were more sobering. On two missions where aircraft were shot down a late change in tasking precluded effective SEAD support. Though it may be overreaching to attribute late changes as the cause of these losses, one downed officer was quite direct in his assessment: "I believe my shoot down was directly attributable to a breakdown in support. The SEAD support we needed was left on the tanker. This confusion was the result of a last minute change and little or no precoordination."[54] Similarly, two other shoot downs occurred on a mission where higher headquarters directed a change, but none of the mission participants got the word. Tasking was supposed to be cancelled because SAM defenses in the target area had not been rolled back sufficiently. The mission was nevertheless executed with insufficient SEAD support.[55]

These types of problems comport with findings in the *Gulf War Airpower Survey* (GWAPS) and TAB 91-2. GWAPS investigated this issue by reconstructing three randomly selected missions where changes in asking occurred and found significant breakdowns in composite mutual support.[56] TAB 91-2 also found that "the number of target changes attempted early in the air campaign was large and the method of implementing change left many of the key players unaware that the changes had been made resulting in missed tankers and occasionally aborted missions."[57] The TAB further stated that, "The most difficult factor in executing the ATO was the constant last minute changes. A cutoff time needs to established and adhered to based upon take off time of TOT after which there will be no changes except tactical emergencies."[58]

Beyond this recommendation, responses in the ALS indicate that a process also needs to be developed for coordinating composite mutual support *in* tactical emergencies. Here, the Airborne Command Element (ACE) on AWACS can play a key role. The ALG was unanimously critical of the ACE during Desert Storm. The following mission commander comments are characteristic.

- AWACS is a great platform manned by dedicated people, but they were not properly tasked to assist in coordination . . . they did not provide proper support to the people handling iron.
- Prior to Desert Storm, I would have said leave it to the mission commander. But having done it, it ain't easy and is in many cases impossible.

- AWACS was unwilling to precoordinate . . . they would leave it to the ACE who we could not contact on the ground or in flight. On those few occasions we did make contact in flight. They were worthless for real-time decision making.
- The element I needed most as a composite force mission commander was an active ACE. I needed current weather, force composition, threat updates, and so forth. I'm sure I attempted contact with the ACE at least ten times during the war (most often in the first ten days) and they were unable or did not have the information I wanted on my packages. Because of Flags and other exercises, we might be able to refrag while airborne if we had an ACE with a clue.

Finally, synergy in the SMS was largely dependent upon the coherence of centrally directed tasking and this also was jeopardized by frequent changes. There was little or no quality control at subordinate levels due largely to impediments to coordination. If tasking was not perfect when it was received, it was difficult for mission commanders to identify errors and fix them in time—particularly, when higher headquarters began "calling audibles." As one squadron commander noted: "Once tasking started coming by phone it became obvious we had no real assurance regarding what support would actually show up. What I did was put my lieutenants on the phones to dial constantly against the busy signals in an attempt to verify tasking with every supporting unit." The ALS contained many similar anecdotes about flawed ATOs. One of the most dramatic examples was just cited earlier—the failure to cancel a mission for insufficient SEAD support. In other cases, a failure to task tankers resulted in major cancellations. Many aircraft were reported "nearly lost" due to fuel starvation for want of prestrike or poststrike refueling assets.

To summarize, the ATO system did not keep pace with changes in operational priorities during the first ten days of the war. Both telecoordination of the ATO and rapid changes in tasking put pressure on an intraunit coordination system that was lethargic from the start. This often resulted in the degradation or breakdown of composite mutual support due to failures of coordination or a lack of a quality assurance process for vetting ATO errors. These problems were self-evident to many airmen, but probably quite difficult to measure sitting in the Black Hole. Here, flying activity boards and AWACS video presented the pretense of composite mutual support, but it did not always exist.

Responsiveness in the 7440th CCW(P)—Even though the Proven Force staff endured the lengthy process of generating ATOs daily, all that was really required to execute tasking rapidly were the target, aircraft, time, and desired effects. For all practical purposes, the time required to coordinate composite mutual support was not a limiting factor. On several occasions, mission briefings were interrupted and tasking altered minutes before takeoff. In these cases, mission commanders used the parameters of the original mission as a template for briefing changes en masse, and operations were conducted without degradation in composite mutual support.

This same responsiveness was also evidenced in flight. Here, positive control by mission commanders permitted reconfiguration of packages to account for a variety of contingencies. The abort of SEAD aircraft, for instance, might result in assignment of new SEAD objectives, new ATTACK package objectives, or allocation of ATTACK aircraft in support of SEAD objectives. Fallout of air refueling assets was also diligently managed in accordance with targeting priorities. Relatively complex adjustments for weather were also possible because all participants shared an exact template that provided a basis for deviations. In other words, maintenance of composite mutual support was a dynamic process characterized by successful adaptation to contingencies

Adaptability

What is Adaptability?—Sir Michael Howard once remarked, "I am tempted to declare dogmatically that whatever doctrine the Armed Forces are working on now, they have got it wrong. I am also tempted to declare that it does not matter that they have got it wrong. What does matter is their capacity to get it right quickly when the moment arrives."[59] The point is well taken. At the onset of hostilities and throughout the course of every war, doctrine must continually be revamped. Regardless of how forward looking it is in peacetime, modifications will always be required to suit the particular characteristics of a conflict. From one point of view, war is a battle of doctrines. Most obviously, adjustments will be required based upon the enemy's *modus operandi*.

The USAF experienced this during Desert Storm. Forces that trained for a "low altitude war" executed a "high altitude war." F-111s "plinked tanks." F-4Gs transitioned from SEAD to destruction of enemy air defenses ("DEAD"). Fast FAC and Hunter Killer missions were revived with some new twists.[60] Such adaptations do not come without effort. Situational awareness, creativity, and persistence are generally required to implement substantive changes, and war tends to reduce these commodities. For purposes of this thesis, adaptability is a measure of an organization's ability to modify its doctrine during war.

In his book, *The Dynamics of Doctrine: The Changes in German Tactical Doctrine during the First World War,* Timothy Lupfer makes a compelling case that wars can be won or lost depending upon the capacity to adapt tactical doctrine during war. He shows how tactical effectiveness underpins operational and strategic effectiveness, and how tactical effectiveness depends upon continuous adaptation. In a similar way, the ability of USAF forces to adapt doctrine during war may be critical to achieving desired effects with minimum attrition.

Adaptability in the SMS—One can get some sense of the obstacles to tactical adaptation in the SMS by examining the phases of the process that Lupfer identifies within the German army during World War I. These include the following.[61]

The Process of Doctrinal Adaptation

- perception of the need for change
- solicitation of ideas
- definition of change
- dissemination of change
- modification of procedures, organization, or equipment
- training and implementation
- subsequent refinement

Such a process was extraordinarily difficult in a dispersed monolithic structure because there was no forum for evaluating composite force effectiveness on a mission-by-mission basis. Even where perception of the need for change existed, the dialogue required to effect change was obstructed by inefficiencies of communication.

For instance, if a mission commander was dissatisfied with the employment of a support package on a particular mission, he may have been able to reconcile the problem with that particular package commander, but how could he ensure the lesson would not have to be relearned again with different package commanders? He could not. Furthermore, unless the deficiency was life threatening, mission commanders were deterred by the difficulty of tracking down individuals by phone, and compelled to let matters go because preparation for the next mission was more urgent. About 80 percent of the ALG had some means for passing along the most important "lessons learned" internally,[62] but only 16 percent reported regular cross talk with companion units. As a result, composite force adaptation proceeded at a slow pace—and, as one mission commander said, "Progress had a kind of a Helen Keller air about it."

Most substantial adaptations within the SMS depended on the initiative of a few staff members working in the Black Hole. By all accounts, they proved extremely aggressive and creative in solving a multitude of complex problems. The drawback of this dependency, however, was that the system did not take full advantage of the unique and vital perspectives of air leaders flying point everyday.[63] Thus, a certain threshold of ineffectiveness (or disaster) was required to stimulate centrally administered adaptation. This deficiency was most clearly evidenced in the failure to "get the ACE onboard with mission commanders."[64]

Adaptation in Proven Force—In contrast, the process described by Lupfer was a resident operating procedure within Proven Force. It began with a dialogue between aircrews in the planning process and continued with constructive criticism of performance in mass debriefings. Lessons were learned with full access to the community of expertise and creativity of all combatants. The effects were catalytic. The process of adaptation was both rapid and firmly grounded in composite (or common) sense. As one Proven Force operations officer noted, "Total quality management of the combat

problem resulted in the continuous improvement of combat operations throughout the war."

This capacity for adaptation was most clearly evidenced during the first ten days. While forces in the SMS had four months to deploy and prepare for combat, most Proven Force assets arrived weeks before hostilities. Some arrived a day after the war began and flew combat missions the next day. Numerous "glitches" on the first few missions were rapidly mended through the debriefing process. As the war progressed, simplicity of coordination allowed complex synergies to develop to meet the specific requirements of the war and exploit the unique capabilities of the wing.

Wild Weasel support soon became both intricate and highly effective—even in those cases where a limited number of aircraft supported multiple ATTACK packages.[65] Relatively complex electronic warfare and deception operations were conducted through close coordination with EC-130, EF-111, KC-135 and RC-135 standoff support aircraft. A limited number of F-15s simultaneously supported composite packages, high value airborne assets, and ran twenty-four hour-a-day combat air patrols to block the flight of Iraqi aircraft to Iran.[66] Initially, AWACS was not particularly helpful, but rapid learning quickly resulted in excellent support of mission game plans. Air refueling operations and procedures were entirely mission oriented. RF-4Cs were integrated to provide reliable battle damage assessment (BDA) and prestrike reconnaissance. Even ground control of intercept (GCI) and air defense controllers were involved to improve the launch and recovery process.

At the command level the story was the same. The wing commander, the deputy commander for operations, or a member of the battle staff was present at every mission debriefing to improve combat support. Moreover, they were extremely responsive to mission commander requests and advice. Members of the battle staff were available to address problem areas on every single mission. In sum, the wing developed a composite intellect that was much more then the sum of its parts. It was both sensitive to requirements for change and possessed a unique capacity to adapt. All of this was the result of collaboration on a single base under one commander.

These advantages cannot be quantified by comparison with SMS operations. There are no objective measures (such as attrition) by which to gauge rates or effects of adaptation. But two observations are compelling. First, interunit debriefing was minimal in the SMS and debriefing is a logical precondition for adapting composite doctrine during war. Second, the capacity of a composite wing to adapt has been handily demonstrated to USAF airmen during flag exercises since 1975, and is well documented in nearly 20 years of flag exercise final reports.[67]

Resiliency

What is Resiliency?—Resiliency is the capacity of a system to function in the aftermath of an attack. Neither the Proven Force or the SMS was subject

to effective attack, but it is still possible to draw useful conclusions about their resiliency in the context of Desert Storm. The SMS presented lucrative "single-area" targets whose destruction may have jeopardized operation of the entire system. The incorporation of a few composite wings would have made this structure more resilient. Three examples make the point.

First, the USAF's highly centralized control system was remarkably vulnerable to a decapitation attack. Destruction of the Black Hole would probably have precluded effective control of composite air operations for an extended period.[68] On the other hand, had higher headquarters been buttressed by a secondary echelon comprising a few composite wings, the system would have been much more resilient. Command relationships with Proven Force illustrate this point. Tasking was a hybrid of ATO and mission type orders (MTO). The wing operated for extended periods as an "air force within an air force"—using its autonomous capacity for composite air operations to pursue broadly defined objectives. This is one of the great strengths of a composite wing. It allows the JFACC to expand the prerogative of subordinate commanders or maintain tight control depending upon the exigencies of the situation.

Second, the monolithic organization of vital support aircraft created lucrative aircraft targets for the enemy. For instance, a successful attack on Shaikh Isa might have destroyed the USAF's entire Wild Weasel capability. Similarly, an attack on Riyadh might have left the USAF with little or no AWACS, Joint Surveillance Target Attack Radar System (JSTARS) and Airborne Battlefield Command and Control (ABCCC) capability.

Third, SMS communications systems themselves were quite vulnerable to attack and the USAF had no reserve infrastructure to replace these systems had they been destroyed.[69] Not only were systems vulnerable at each base, but the entire system might have been brought down with the destruction of a few key nodes.[70]

To summarize, although many constraints (addressed later) determined the physical organization of air assets in the SMS, modest dispersal of vital capabilities and integration of these assets into a few composite wings would have had some clear advantages.

Agility of Communications

What is Agility?—Strategic agility is the ability to project forces across the globe and rapidly employ them once they get there. Desert Shield clearly set new standards in the former regard. Yet, in spite of the rapid deployment of air forces, actual readiness for combat operations was hampered by (among other things) the division of air forces into penny packets without a communication infrastructure to tie them together. Agility of communications is a measure of the time required to deploy and field communications prerequisite to composite force employment.

CAFMS Buildup—An average of five weeks passed from the time SMS units arrived at their forward-operating location (FOL) until their CAFMS was operational.[71] Many commented that it was another two to three months before their system was "fully debugged." Moreover, not all squadrons had CAFMS. Several in the ALG described how they "bootlegged" CAFMS products from other collocated units. This produced delays and incomplete access to mission planning information.[72]

Telephonic Communications—An average of two weeks passed from the time SMS units arrived at their FOL until they possessed a secure telecommunications with other units and higher headquarters. The actual buildup of communications capabilities was uneven. Sixty-five percent of the SMS had a secure capability within a week. The remaining 35 percent waited an average of 31 days.[73]

Numerous obstacles converged to delay the communications buildup. First, the decision was made early to deviate from priorities in operational plans by emphasizing deployment of aircraft at the expense of supporting resources—including communications infrastructure.[74] Second, most bases were "bare-base" in the sense that indigenous communications infrastructure was marginal or nonexistent. Third, there were political problems associated with access to Saudi Arabia's communications systems. Fourth, because many GCC air bases were physically larger than typical USAF air bases, they required more extensive communications infrastructure than that called for in war plans.[75] Fifth, many organizations were negligent in assessing communications requirements at FOLs, resulting in unexpected demands.[76] Sixth, significant infrastructure was required to manage the flow of communications on limited frequency band-widths and much of this was erected from the ground up.[77] Finally, there were fundamental interoperability problems between KY-58/68, STU-3, and HF systems that encumbered coordination processes.[78,79]

By the time the war began, the average squadron in the SMS had three secure lines (shared by five users) that were immediately accessible, but variance was significant.[80] A few squadrons had only one secure line while others had as many as six. Many wings continued their communications buildup well into the war.[81] About 60 percent of the SMS had a secure telefax capability when the war started.

There is no doubt the communications infrastructure would have received higher priority if USAF forces were fighting their way in, but would this have helped? CAFMS clearly would have been moot for an extended period. Similarly, according to the CENTAF officer in charge, installation of secure telecommunications also proceeded about as rapidly as it possibly could have given deployment priorities and personnel and equipment limitations.[82] While there are many potential solutions to this problem (addressed later), composite organizations are one way to reduce dependence on deployable communications infrastructures. As the Proven Force demonstrated, a composite wing is ready to coordinate composite air operations upon landing at its FOL.

Real and Potential Implications for Combat Effectiveness

One would expect breakdowns in composite mutual support such as those described in the SMS to be evidenced in terms of higher attrition rates.[83] In the case of Desert Storm, however, attrition rates were incredibly low. The USAF had only fourteen combat losses during the entire war for an overall attrition rate of one-twentieth of one percent.[84] Thus, attrition rates alone provide equal grounds for concluding that composite mutual support was either outstanding or irrelevant. The difference, of course, is how one characterizes the actual pressure Iraq brought to bear on USAF forces.[85]

Overall, the ALG was not very impressed by the Iraqi fighter opposition. Most expressed the view that ESCORT/SWEEP was relevant primarily as a deterrent to Iraqi air operations.[86] SEAD support, on the other hand, was considered essential on about 64 percent of missions flown during the first ten days. Thus, it is probably a mixed case. F-15 ESCORT/SWEEP aircraft probably had a nominal impact on attrition, while SEAD aircraft likely had a measurable impact on loss rates. Perhaps the more important questions are hypothetical.

Eighty-five percent of the ALG expressed the view that USAF dependence on telecoordination was a serious weakness that might have been exploited by a more competent adversary using the same Iraqi resources. This view is reinforced when one considers that virtually all pressure on USAF control systems was self-imposed. The three principal exceptions during the first ten days include the Iraqi SCUD missile campaign, bad weather, and the Iraqi armored thrust at Khafji. None of these influences can be characterized as a source of significant stress. Yet, the limits of responsiveness in the SMS were clearly tested under these relatively benign conditions. This stress can only be explained then, as the product of structural limitations of the USAF control system itself, combined with an internally generated demand for high combat tempos and frequent changes in tasking. The essential question, therefore, is how responsive would the system have been in a nonpermissive environment.

The USAF had over four months to deploy and train a monopoly of air forces in-theater, build an air campaign, plan and fully coordinate the opening volleys, and also to deploy, test and reconfigure communications infrastructure. Once the war began, the enemy essentially immobilized his ground and air forces while they were pummeled to irrelevance. Chemical weapons were not employed. Not a single USAF air base operated under serious duress. In sum, this was a one-way war against a passive and dim-witted opponent and any forward-looking appraisal must take these factors into account. Future adversaries will.

USAF concepts of operations for Desert Storm would certainly have been modified entering a more hostile environment, but how well would resident control concepts and communications infrastructures have worked? Furthermore, to what extent could these systems have been modified? Seen in this light, the limits of synergy, responsiveness, adaptability, resiliency, and

agility in the SMS are all quite relevant in spite of USAF success. In a less permissive environment, a few composite organizations might have been quite important. Yet, as the next chapter shows, these advantages do not come without a price.

Chapter 6

Relative Advantages of Monolithic Wings

Introduction—The principal advantage of monolithic wings in combat is logistical efficiency. This chapter explains this advantage, and also highlights tradeoffs between monolithic and composite organizations in the context of Desert Storm. The objective is to identify factors that determine points of diminishing utility in both organizations.

Logistical Efficiency

What is Logistical Efficiency?—For purposes of the thesis, logistical efficiency is a measure of a wing's capacity for sortie generation versus the total logistical resources required to generate sorties in a given period of time.[87] In a monolithic wing, collocation of a relatively large number of similar aircraft types allows for pooling and economical distribution of scarce logistical resources to maximize sortie generation. This should sound familiar. Just as the composite wing improves the quality of composite mutual support by avoiding the friction that comes with the dispersal of its component forces, so the monolithic wing improves the quality of logistical support by avoiding dispersal of resources that can leverage sortie generation. The principle is the same, but the objectives are countervailing to a point. Just where that point is depends upon the resources required for sortie generation or the logistical "pull" of an aircraft unit, versus the logistical "depth" built into that unit and resources available for its resupply over time. A brief examination of logistical and operational constraints in the SEAD and ESCORT communities during Desert Storm illustrates the trade-offs involved and factors that determine diminishing points of return.

Logistical Efficiency in the SMS—In the 35th TFW(P) at Shaikh Isa, trade-offs between composite and monolithic organizations were fairly severe. The 35th TFW employed 48 F-4G aircraft: half from the 81st TFS, and half from the 561st TFS. This was the sum total of the USAF's Wild Weasel capability in the GCC during Desert Storm. Several operational advantages might have resulted by deploying these squadrons separately as components of composite wings. Most importantly, dispersing these assets would reduce a key USAF vulnerability. Second, lateral dispersal would have increased operational flexibility because the effective range and endurance of F-4Gs could be increased by basing Wild Weasels such

that missions objectives were closer to respective bases.[88] Third, integrating these assets into composite wings would have provided operational planners with some "heavy hitters" that possessed the advantages of synergy, responsiveness, adaptability, resiliency, and agility. As one operational planner explained, "Not all target areas were equally difficult. We could have used some composite wing hammers that included F-4Gs to take on the more difficult taskings and react rapidly."[89]

On the other hand, collocation of these aircraft had distinct advantages in terms of logistical efficiency.[90] These advantages come in several categories. First, collocation allowed squadrons to share personnel and equipment to distribute work loads and compensate for temporary personnel losses. Second, pooling of Wartime Readiness Spares Kits (WRSK) allowed a marginal increase in the availability of spare parts for both units. Third, as a second generation aircraft, the F-4G required a certain level of intermediate-level maintenance and depot repair in the field. Neither squadron possessed the organic depth of intermediate level test equipment, parts, or specialists to support the sortie rates they achieved acting together over the long term.[91]Fourth, the F-4G has a relatively low mission-capable rate. Collocation of these squadrons permitted cannibalization of fewer "hangar queens" between the two units.

Furthermore, it might permit intraunit scheduling substitutions to fill flying schedules. For instance, if one squadron had a spare that was not being used, the other unit could borrow that spare if its own abort rate exceeded that programmed. Fifth, collocation of these squadrons reduced intra/intertheater airlift requirements. A monolithic organization allowed for single point resupply of all F-4G assets in-theater. Had the two squadrons been dispersed, direct intratheater airlift requirements might have increased somewhat, and an intertheater shuttle and special communications links might have been required for "logistical mutual support" between these units.[92] Thus, dispersion might slow the distribution of scarce resources to theater, between these units in-theater, and there would be some opportunity costs in diverting scarce airlift from other tasks.

All this said, the costs of dispersing these squadrons could have been mitigated almost entirely by increasing the logistical depth of each unit prior to combat operations. Sufficient resources existed within the F-4G logistical system to buttress WRSK, manpower, and to create two intermediate level maintenance organizations in the field.[93] Just as importantly, time was available to do so. F-4G utilization rates at Incirlik AB suggest that both 35th TFW(P) squadrons could have conducted relatively autonomous operations with only modest degradation in sortie generation capability given sufficient preparation.[94]

In retrospect, the trade-off was between survivability and responsive hitting power on the one hand, and the cost of building logistical depth to support two F-4G squadrons on the other. But this was certainly not the trade-off CENTAF planners faced. Time was required to build this capability and no one knew how much time was available. Collocation made the utmost

sense because of the shallow logistical depth resident in the system at deployment and uncertainty concerning when the storm would break.[95]

F-15 ESCORT aircraft were a different story. Logistical costs of dispersal were less significant for several reasons. First, as a third generation aircraft the F-15 has a relatively low logistical pull.[96] Second, F-15s were much more plentiful than SEAD assets. Third, there was substantial logistical depth at the squadron level and within the F-15 logistical system. Consequently, F-15 squadrons could operate in a dispersed mode with relative logistical autonomy and several in fact did.[97] In retrospect, deeper integration of F-15 escort squadrons into composite wings with strikers could have been achieved at relatively little cost.[98] In several cases, there would have been almost no costs because bases were large enough to support the employment of multiple wings. As it happened, the advantages of ATTACK/ESCORT integration were not relevant during Desert Storm because most of the Iraqi air force stayed home. Had they instead attempted to shut down USAF air operations and/or put up an active fighter defense, composite organization of ATTACK and ESCORT might have paid big dividends for both air base defense and offensive counterair operations.[99]

Logistical Efficiency in Proven Force—The utilization rate of Proven Force assets equaled or exceeded that of most units in the SMS.[100] This was possible as a result of two factors. First, Incirlik AB has an advanced logistical infrastructure.[101] Second, supporting organizations simply did whatever was required to make the logistics work.[102] Thus, comparisons of logistical efficiency between Proven Force and forces in the SMS are not meaningful. It is clear, however, that a Proven Force-type wing in the GCC would have required greater logistical depth than its monolithic equivalent to achieve identical combat tempos.

In summary, logistical efficiency is not the same as logistical effectiveness. The operational advantages of a composite wing can be "bought" by purchasing increased logistical depth and in some cases costs will be nominal. On the other hand, robust composite wings usually require extensive cost-benefit analysis. A wide variety of logistical factors must be considered, but the following are key: (1) the logistical "pull" of component forces; (2) their organic depth; (3) the depth resident in supply systems; (4) the duration of the conflict; (5) desired combat tempos, and (if logistical depth is deficient); (6) the time available to fill the vessel before war begins.

Chapter 7

Determinants of Force Structure for Desert Storm

In his book, *Essence of Decision,* Graham Allison makes the case that the behavior of a large system in pursuit of a goal cannot be completely explained as a consequence of rational decision making at the top. Competing political imperatives modify behavior and often result in sacrifice. Similarly, organizational routines and standard operating procedures set constraints that modify actual versus desired performance. Interviews with CENTAF personnel show some of these factors at work during the deployment for Desert Storm.[103]

CENTAF had a plan (in draft) for the deployment of USAF forces in-theater, but like many contingency plans it was based upon wishes and guesses about the availability and capabilities of air bases.[104] Site surveys were not complete. Basing options were still being negotiated with Saudi Arabia. Moreover, the forces actually deployed for Desert Storm were drastically different and far exceeded in scale those called for by the plan. Finally, since no time-phased force deployment list existed, the entire deployment required "hand massaging."[105]

To complicate matters further, Saudi Arabia and the other GCC states imposed a number of political constraints that made the deployment more chaotic. First, the availability of air bases was not determined prior to deployment. Rather, landing rights were dribbled out little-by-little over a period of time. In some cases, this delay resulted in units departing CONUS without final confirmation of landing rights.[106] Second, CENTAF had hoped for landing rights at GCC international airports (as many of these offered the best infrastructure for USAF operations), but only support aircraft were allowed at these bases. Finally, the deployment of particular types of aircraft was sensitive, and this also caused some perturbations.

CENTAF's primary objective during the initial deployment phase was deterring further Iraqi aggression against Saudi Arabia. The principal criterion for selection, sequencing, and beddown of forces was not operational capability per se, but a show of force. Units were selected according to their ability to deploy with the utmost speed, basing was determined primarily by political availability, and much of the support equipment required to conduct combat operations was temporarily left behind to expedite the appearance of aircraft in-theater.

Meanwhile, supporting logistical organizations executed the tasks for which they were designed. They reinforced the initial deployed structure as rapidly as possible to minimize closure-time and maximize supportability. Although CENTAF continued to provide central guidance based on operational considerations, its degree of freedom to alter the unfolding force structure was rapidly reduced. USAF units, sister services, and Coalition air forces all competed for airlift and ramp space. Each force increment that arrived in-theater set constraints for deployment of follow-on forces. Pressure to achieve operational readiness was building as show-of-force objectives were met. Indeed, the entire air structure became an interconnected puzzle largely of its own making. It became increasingly difficult to move any one piece without shifting many others and disrupting the buildup. The result was a structure that was operationally workable, but suboptimal.[107] Although most air bases supported many disparate aircraft, collocation was largely a matter of happenstance. Some operational adjustments were considered, but the costs of readjustment rendered such readjustments moot.

In summary, though CENTAF planners exercised centralized control of the deployment by setting objectives, the air structure in the GCC was also determined largely by political factors, the capricious nature of initial deployments, and the routines and standard operating procedures of supporting organizations. As Gen William Pagonis noted, the first law of logistics is that mass times velocity equals momentum. Once the deployment machinery got rolling, it became almost impossible for air planners to "tweak" the system to maximize operational efficiency.[108] Ultimately, all these factors defined the terms of employment for composite air operations during the war.

Chapter 8

Conclusions

Introduction—This foregoing analysis provides evidence of potentially serious vulnerabilities in the USAF's conduct of composite air operations during Desert Storm. The point is not to criticize this hugely successful campaign or even to suggest it should have been done differently. Rather, the question is how can the USAF better prepare for composite air operations in future contingencies? The answer comes in two parts. First, there are straight-forward measures the USAF can take to improve composite air operations among dispersed monolithic forces. This chapter gives recommendations based upon comments received in the ALS and TAB 92-1. The aim of these efforts is to make coordination more like that in a composite wing—by duplicating the mission data cards, master maps, providing for the transmission of conceptual information, and doing all this rapidly. The subsequent section considers the proper role of composite wings.

Technical and Training Recommendations

1. Coordination Requirements—Composite air operations can be improved by formalizing coordination requirements in peacetime (along the lines pursued by CENTAF). MCM 3-1, volume 1, should be updated to include worldwide standard packaging options, tactics, and mission commander coordination orders.[109]
2. CAFMS Follow-On Capabilities—CAFMS is currently being integrated into a new software environment called Centralized [Tactical Air Control] Automated Planning System (CTAPS). This system speeds data transfer and is more user-friendly, but the USAF should continue to push the state of the art.[110] The following capabilities are important.
   a. Follow-ons should incorporate worldwide MCO formats. These should be amenable to editing and printable for use on aircrew kneeboards.
   b. Follow-ons should incorporate MCO bulletin boards for interactive electronic communication between aircrew members.
   c. Follow-on MCOs should incorporate templates that hold the route coordinates and times of various mission packages. This data should be readily transferrable to and from an MSS. Ideally, users should be able to print all mission routes and times on a single map if desired.

d. Follow-ons should allow "logging the receipt of MCOs" by date-time group so mission commanders can verify all players are reading from the same sheet of music.
e. Follow-ons should allow for rapid manipulation of all ATO information. For instance, a mission commander should be able to examine the mission assets, target information, time, and desired effects and print these data (even if the ATO is not fully constructed). Similarly, he should be able to view or print maps of the entire airspace management plan (or portions of it) in lieu of manual reconstruction from coordinates.
f. Follow-ons should aim at revolutionary advances in speed, reliability, and agility.
g. Follow-ons should incorporate a rapid laser print capability.
h. Follow-ons should not be intended a substitute for secure voice communications. There is no silver bullet that can assure precoordination. Multiple communications channels and redundancy are required.

3. Distribution and Training—CAFMS had marginal utility for coordination during Desert Storm not only because of the limitations of the system itself, but because aircrews were not trained to use it properly.
   a. Fighter Weapons School graduates, mission commanders, mission planning cell and fighter duty officer (FDO) designates, and Airborne Command Element (ACE) personnel should all be expert on system follow-ons.
   b. All flying squadrons should be allocated a follow-on system for training purposes and maintain a second system in WRSK.
   c. Follow-ons should be routinely employed during daily flying operations and in exercises.
4. Color Copiers—Color copiers were invaluable during Desert Storm for rapid distribution of maps. Squadrons should be allocated a color copier in WRSK.
5. Secure Communications Capabilities—The number of secure telecommunications lines allocated to individual units during Desert Storm was inadequate in many cases.
   a. Flying squadrons should be allocated a minimum of six secure telecommunication lines: one for the commander, one for maintenance, one for intelligence, one for the mission planning cell, and two for aircrews.
   b. Communications systems should be organic to individual squadrons and personnel should train and exercise in self-setup.
   c. Communications systems should incorporate a rotary to automatically pass incoming calls through available lines in the event of a busy signal.
   d. Flying squadrons should be allocated a minimum of free secure FAX machines. FAX machines should have the capability for rapid simultaneous transmission up to ten receivers, a toggle for selecting a receive only mode, and a capability for date-time group confirmation of receipt (initiated by a human being).

e. Utilization of frequency bandwidth must be improved at the theater level.

f. Substantial improvements are required to buttress the resiliency of USAF communications systems in general. Systems require greater reliability, more redundancy, and more logistical depth. Follow-on architecture should seek to reduce the number of key nodes.[111]

6. Teleconferencing Capability—The USAF should eventually acquire secure, deployable, audiovisual teleconferencing systems. In the meantime, several in the ALG made these recommendations.

   a. Phone teleconferencing "should allow package commanders to dial into a conference call with the mission commander at times specified in planning guidance" (e.g., "X" hours prior to the beginning of TOT block for precoordination and "X" hours after the TOT for debriefing). One mission commander went further:

   > The mission commander should be able to dial up all mission participants simultaneously. Maybe they could design a system so that teleconferencing phone numbers change automatically with mission number changes in CAFMS. The mission number would ring all participants. Derivative mission numbers would ring particular units. Conventional unit phone numbers would still exist as a backup if CAFMS was in error or running behind.

   b. A related suggestion was to centralize all MPCs at the TACC. As one squadron commander put it:

   > The best return on investment would be to have the right people plan the missions face-to-face in the first place. I would put my best tacticians in the TACC and do the job right in the first place to reduce the need for coordination. Whatever the solution, follow-on coordination systems should permit parallel distribution and receipt of information and group interface. Furthermore, procedural changes are required so that "briefing and debriefing" times are at least considered (if not precoordinated). No matter how good a CAFMS follow-on system gets, there will always be the problem of finding and talking to the man with the plan in time.[112]

7. ACE and Mission Commander Roles—There was considerable confusion during Desert Storm concerning the role of the mission commander vis-á-vis that of the ACE. Many mission commanders expected support they did not get. A few felt over-controlled and/or expressed the view that the ACE often did not know who they were or what they were doing.[113]

   a. Mission commander and ACE roles should be scrutinized regarding responsibilities and prerogatives. Explicit guidance should follow at the onset of any contingency.

   b. Mission commanders and ACEs should attend formal training programs and perform in these roles during exercises. Both should be

experienced aviators who are intimately familiar with the capabilities and limitations of all USAF platforms.

c. Mission commanders on the ground must be able to call an airborne ACE before they fly and vice versa. Moreover, the ACE should have airborne access to MCOs and/or a FAX capability.
d. The ACE can play a key role in providing a "mission picture" to airborne mission commanders en route regarding weather, fallout or status of aircraft, and threat updates.
e. Furthermore, ACE involvement is critical for "refragging and repackaging" of airborne aircraft during tactical emergencies.
f. In some cases, it is desirable that particular units field their own ACE or send representatives to assist in support from other standoff platforms. These requirements should be thought through in peacetime.

8. FDO and MPC—Unit manning must be sufficient for the creation of a 24-hour MPC and the dispatch of FDO augmentees. MPC and FDO personnel should be predesignated by units, they should receive formal training, and they should participate in these roles during exercises.
9. Flag Exercises—Flag exercises played a critical role in training aircrews for composite air operations in Desert Storm. The ALG made numerous unsolicited remarks to this effect. Coordination was possible under degraded conditions largely because of these exercises. One squadron commander summed it up this way: "In my estimation, Red Flag/Cope Thunder was undoubtedly the single peacetime training that contributed the most to mission success."
10. SEAD Requirements—The gut feel of the ALG was that SEAD assets intervened on about 65 percent of all missions during the first ten days of Desert Storm (i.e., to preclude or interrupt an enemy engagement). Many said there were never enough F-4Gs. Furthermore, several expressed concern that these capabilities are rapidly disappearing from USAF force structure—and, although new systems are being worked, that there may be an extended window of vulnerability before follow-on systems are fielded. This concern seems justified given the rapid proliferation of third generation SAM systems throughout the world.[114] This issue was not a subject of research, but is noted because it surfaced with some frequency both in the ALS and in follow-up interviews.

Implications for the Composite Wing

This thesis does not assess the relative merits of permanent, exercised and ad hoc composite wings. It does, however, draw conclusions about the potentialities of composite wings based on the foregoing analysis of strengths and weaknesses.

Lesser Regional Contingencies (LRC)—The composite wing is particularly well suited for lesser regional contingencies. Composite wings

allows CINCs to "take the tools they need off the shelf" and employ them in a task-organized configuration that can greatly enhance mission effectiveness. Furthermore, logistical inefficiency is less of a problem because the wing can (if necessary) draw on the idle resources of the entire system to achieve sufficient logistical depth.

The unique strengths of a composite wing (particularly a permanent composite wing) have special significance in such conflicts. Vince Lombardi was fond of the admonishing that practice doesn't make perfect. Perfect practice makes perfect. The adage has real meaning in today's LRC environment. Military operations in LRCs tend to be extraordinarily political in character. Positive US aims are generally limited, therefore, a large number of competing political objectives exercise a restraining influence on the conduct of military operations. Rules of engagement tend to be complex. Operations may require secrecy. Every sortie may be a "political" sortie and every bomb a "political" bomb. In such an environment, even minor errors in employment can have significant international repercussions. Furthermore, the loss or capture of even one downed aircrew or the killing of one civilian may be simply unacceptable. In such circumstances, USAF composite air operations cannot be merely good; they must be perfect.

Perfection depends upon a quality of coordination that can only be achieved by face-to-face briefings and positive control by a mission commander and an ACE during flight. Face-to-face briefings permit specificity and agreement regarding the parameters of employment and responsiveness to changes in mission guidance. Positive control inflight improves the chances of good decison making and unanimous action in response to unforeseen events. Debriefing facilitates continuous adaptation to improve effectiveness. Permanent composite wings exemplify these characteristics because they train together on a daily basis. This familiarity makes for an elite capability that is rapidly deployable with minimal "gin-up" time in a crisis response situation.

Major Regional Contingencies (MRC)—The USAF demonstrated an incredible power projection capability during Desert Storm, but as Gen H. T. Johnson warned, "We are fortunate we did not have to fight our way in."[115] One F-16 squadron commander put it another way: "What really scares me is the fact that we had Desert Shield to use for practice and rehearsal and to iron out all the wrinkles. In the future, I expect that won't be the case." Both comments make an important point. Desert Storm was a set-piece war. In future contingencies, there may be insufficient time for composite force planning conferences, academic exchanges, and the extended build up of communications infrastructure. Substantial hitting power may be required at the front end. Thus, greater consideration should be given to echeloning the force structure at various levels of readiness and capability. In spite of USAF's prodigious technological advantages over potential adversaries, the lead elements of any major USAF deployment should be leveraged to the hilt to hedge against the enemy's advantages of time, distance, numbers, and anything else his planning might allow.

Even just one composite wing can help provide this leverage, but it must be robust. Ideally, the wing would be designed as the supported or supporting arm in a joint team for forced entry in a nonpermissive environment. The wing's primary mission would be to secure a lodgement, deter[116] or slow the enemy's progress, and lay the abutment for an air and sea bridge to support entry of follow-on forces.[117] The wing would function as a temporary TACC during the buildup phase, and as a backup once the primary TACC was functional. All key capabilities required to accomplish this mission would be organic to the wing, but all need not be collocated in peacetime.

This capability may require some investment, but alternatives may be more expensive. For instance, if a competent opponent can temporarily deny access to key bases in-theater, the USAF may be forced into air operations from far away locations at low or ineffectual combat tempos. Furthermore, the enemy's initial success may buy him time for preparations that ultimately make forced entry extremely costly. A highly tempered first echelon might forestall such developments, but this requires the strategic agility of air power and the leverage of a robust composite wing.

All this said, the composite wing can only be the tip of the spear. The bulk of follow-on forces must be monolithically organized for logistical efficiency. There are two exceptions. First, as Proven Force demonstrated, the composite wing can play an important role by opening a strategic flank and forcing the enemy to fight a two-front war. Second, there will generally be an imperative for modest dispersal of high value airborne assets (HVAA) and other scarce support platforms to improve resiliency—and this presents opportunities to build composite leverage.

The dispersal of SEAD assets, in particular, would create opportunities for building a few composite wings.[118] Other examples might include collocation of AWACS and Rivet Joint with F-15Cs or collocation of JSTARS with F-15Es. These kinds of determinations should be made in advance to ensure adequate logistical depth for modest dispersal of vital resources.[119] USAF war plans should be crafted accordingly and exercised. If this is not done, the USAF runs the risk of deploying a replica of its former peacetime self.

USAF doctrine prescribes that "forces should be organized for combat effectiveness versus peacetime efficiency,"[120] but it is unclear by what process the logistical bureaucracy realizes this goal in a time of crisis.[121] As Desert Shield illustrates, the capability to make the transition from a monolithic peacetime structure to a well-reasoned combat structure requires careful planning and exercise in advance. A few composite force modules should be preprepared and exercised so the JFACC can weigh a greater number of deployment options when entering a nonpermissive environment.

To summarize, the organization of air forces in an MRC must be predominantly monolithic, but composite wings can provide critical leverage in the lead echelon, on a strategic flank, or within a larger monolithic structure with modest dispersal of support aircraft.

Conclusion—The purpose of this thesis has been to focus attention on the criticality of composite air operations and the virtues of the composite wing as

an enabling organization. Desert Storm provides evidence of the difficulties of composite air operations in a dispersed monolithic structure. The thesis recommends some fixes. Proven Force provides evidence of the potentialities of a composite wing as a strategic weapon. The thesis suggests how composite wings can add power projection capabilities to the defense arsenal that are critically important and singularly unique.

The current drawdown should focus increasing attention on composite air operations if the USAF is to forge a smaller, sharper sword. *Composite Air Operations* should be written into the USAF's doctrinal lexicon. Furthermore, the USAF must continue to analyze the more cumbersome aspects of composite air operations to build greater flexibility into future force structure.[122] To borrow from Hoffman Nickerson, composite mutual support is the linchpin that allows eggshells to sustain lightening bolts across the broadest spectrum of conflict.

Notes

1. Richard P. Hallion, *Storm Over Iraq* (Washington, D.C.: Smithsonian Institute Press, 1992), 32.

2. The attendant risks of ad hoc air operations generally precluded sustained training effort.

3. Interview with Lt Col Dave Deptula, CENTAF campaign planning staff officer, 14 May 1993.

4. Gen Merrill A. McPeak, "For the Composite Wing," *Airpower Journal* 4, no. 3 (Fall 1990): 4–12.

5. Profiles, objectives, force packaging and threats were quite similar between these units during the early phases of the war.

6. Maj J. Scott Norwood, *USAF Daylight Air Combat Operations in Northern Iraq* (U) (Torrejon, Spain: 401st TFW, 1991), Secret, unpublished (USAF Historical Research Institute: Maxwell AFB, Ala.).

7. In using these survey results there is the obvious risk that memories have faded or events reinterpreted in hindsight. This thesis avoids extensive statistical manipulation of survey data. Instead, the main effort is to (1) characterize the relative importance of factors on a broad scale (i.e., from "not a problem" to "a serious problem"); (2) to roughly gauge frequency; and (3) to determine fundamental causes by analysis of narrative responses and follow-up interviews. Similarly, to minimize the potential for self-censorship, attribution of narrative comments ends at the interviewee's duty title except in those cases where specific permission was granted to use a name.

8. R. Ernest Dupuy and Trevor N. Dupuy, *The Encyclopedia of Military History* (New York: Harper and Row, 1986), 3.

9. See David G. Chandler, *The Campaigns of Napoleon* (New York: Macmillan, 1966), 154.

10. The story of the German Panzer division during World War II is an excellent case in point See Martin van Creveld, *Technology and War* (London: Free Press, 1989), 281.

11. See Martin van Creveld, *Command in War* (Cambridge: Harvard University Press, 1985), chap. 4, "The Triumph of Method."

12. David G. Chandler, *Strategic Concepts*, pt. 3, chap. 15, 161–78.

13. For example, see James P. Coyne, "Fighting in Fours," *Air Force Magazine*, April 1993, 60–65.

14. Notably, a number of factors will reshape this web over the next 20 to 30 years. First, inherent in stealth technology is some degree of offensive air superiority that may reduce requirements for composite mutual support. Second, the development of both standoff

munitions and remotely piloted vehicles will make USAF forces less vulnerable to enemy threats. Third, combat support is increasingly being "relayed" to the battlefield from deep standoff platforms and from space. Fourth, modularization and miniaturization of various technologies will allow multirole fighters to field a much broader array of capabilities on demand. Eventually, a monolithic wing may be able to "upload" whatever combination of capabilities it needs as a composite force to achieve mission objectives. This thesis is primarily concerned with the state of composite air operations in the interim period.

15. Technical expertise is a more important limiting factor than capacity. See *Fort Worth Star Telegram*, "Lockheed Expects Big Layoffs Soon," 20 May 1993, 1.

16. For an in-depth discussion of these vulnerabilities see Williamson Murray, *Luftwaffe* (Baltimore: Nautical and Aviation Publishing, 1983).

17. This trend is well illustrated by the differential in fly-out cost between the B-29 ($250,000 in current dollars) and the B-2 where fly-out cost estimates range between $500,000,000 and one billion dollars. The B-2 wields a lot more combat power, but the consequences of B-2 attrition are also more severe. For B-29 fly-out cost estimates see Marcelle S. Knack, *Post WW-II Bombers* (Washington, D.C.: Office of Air Force History, USAF, 1988), appendix I.

18. Data vary significantly by source and date. This is the author's best estimate based on several unclassified sources. For a rough order of battle depicting all Coalition forces involved see Frank Chadwic and Matt Caffrey, *Gulf War Fact Book* (Bloomington, Ill.: GDW, 1991), 55.

19. In the course of this research the author found considerable evidence that many of the problems examined herein were also pronounced in the joint and Coalition arena. For example, many composite air operations were attempted with the USN, but coordination was rarely successful. Similarly, fast FAC operations were reported to have suffered much owing to the lack of liaison with ground forces. Finally, coordination with Coalition air forces was extremely uneven and these forces were sometimes quite disruptive to USAF operations.

20. About 80 percent of all SMS sorties were composite. Breakdowns by aircraft were F-16 (87%), F-111 (93%), F-15E (40%), F-4G (100%), EF-111 (100%), and F-15C (52%).

21. Reportedly, with stellar results.

22. Colonel Deptula interview.

23. Up to 1,000 pages depending upon the way it was printed.

24. The F-4G Wild Weasel is a specialized aircraft that hunts and destroys enemy SAM and AAA systems.

25. See Capt Thomas G. Shulter, "Composite Wing: Lessons Learned in the Gulf War" in *USAF Fighter Weapons Review*, Summer 1992, 14–16.

26. CENTAF Guidance Letter, obtained from the *35th TFW(P) Historical Contingency Report*, 1 January–22 March 1991 (U), USAF Historical Research Institute. Author's excerpt declassified from SECRET to UNCLASSIFIED by Lt Col Gary Few, 9th AF/DOX, 2 June 1993.

27. Comments in *Tactical Analysis Bulletin* 92-1 (U), July 1991, deputy commander, Tactics and Test, 57th Fighter Weapons Wing, Nellis AFB, Nev., 1-3, 2-5 (F-15s); 4-6 (F-16s); and 8-5/6 (EF-111s) Secret. Information extracted is unclassified.

28. Interview with former CENTAF deputy commander for Command, Control, Communications, and Computers, 14 May 1993.

29. Comments in *Tactical Analysis Bulletin* 92-1 (U), July 1991, deputy commander, Tactics and Test, 57th Fighter Weapons Wing, Nellis AFB, Nev., 8-6. Secret. Information extracted is unclassified.

30. Again, it is very difficult to assess actual transmission time.

31. As one operations officer put it: "Have you ever sent a FAX and wondered whether the other party received it? You got to call them to make sure . . . and since you're calling them anyway who needs CAFMS."

32. This was a big problem. Different units were operating on different flying and crew rest cycles making it extremely difficult to connect with the right individual.

33. Many mission commanders reported that FAX was too slow to be of much use. Moreover, even when sufficient time was available, not all supporting units had a FAX.

34. In two cases, for instance, secure telecommunications at the squadron level were reported out-of-order about half the time during the first ten days.

35. Comments in *35 TFW(P) Contingency Historical Report*, 1 January–22 March 1992 (U), Secret, USAF Historical Research Institute, Maxwell AFB, Ala. Information extracted is unclassified.

36. As one operations officer put it, "We didn't have much time for coordination during the first week. We just did our own job and tried our best not to hit anybody A friendly mid-air collision was the biggest threat."

37. Many units did not have this luxury due to manning limitations.

38. On the face of it, an area coverage approach to package support may seem an economy, but this can easily become a false economy that provides only the pretense of mutual support if aircraft are spread too thin or employment parameters are overly vague due to a lack of coordination. The degradation that obtains with "area coverage" falls off more like a cliff than a gentle slope. Support assets can quickly become irrelevant if they do not meet certain parameters defined by their relationship with ATTACK assets and those enemy forces that are threatening. This is particularly the case with SEAD, but even ESCORT can become irrelevant to ATTACK attrition if these aircraft lean too hard into a SWEEP role or fall behind. There are two bottom lines here. First, there are real trade-offs between the desire for high combat tempos and simultaneity on the one hand, and effective support from scarce support aircraft on the other. Second, the most effective use of scarce resources usually obtains with coordination in detail, not the reverse.

39. When supporting two or more packages, F-4Gs reported coordinating in detail 57 percent of the time; EF-111s, 42 percent of the time; and F-15s, 64 percent of the time.

40. F-16 (12%), F-111 (18%), F-15E (13%), F-4G (.18%), EF-111 (7%), and F-15 (14%).

41. F-16 (16%), F-111 (13%), F-15E (12%), F-4G (25%), EF-111 (10%), and F-15 (13%).

42. Thus, when they reverted to area coverage, support was often degraded from close-in-jamming to a less effective stand-off-jamming mode—or none.

43. In other words, one portion of the package aborts while the rest continues unaware. Such incidents were reported on 7 percent of all missions.

44. This percentage includes only those deconfliction problems in enemy territory (i.e., outside ATO airspace management parameters) that could have been avoided by precoordination.

45. Here, USAF EF-111, USN, and Coalition aircraft presented the greatest problems.

46. On the other hand, the ALG was nearly unanimous in reporting heightened situational awareness and few deconfliction or IFF problems when forces had the luxury of precoordinating ATTACK, ESCORT/SWEEP, and SEAD flow plans.

47. Colonel Deptula interview.

48. Ibid. There was a great deal of concern that the war would soon be over—thus, any substantial change produced the requirement to scrub the entire MAP to ensure vital targets would be hit before a cease-fire.

49. And the advantages of launching the first salvos of the war.

50. F-16 (26%), F-111 (58%), F-15E (43%), F-4G (31%), EF-111 (20%), and F-15 (37%).

51. Colonel Deptula interview.

52. This same sentiment also found its way into surveys because mission commanders often "briefed off the first two days." In other words, they coordinated by saying such things as "fly everything like day one, except turn South earlier."

53. F-16 (33%), F-111 (83%), F-15E (33%), F-4G (.5%), EF-111 (indeterminate), and F-15 (57%).

54. Unsolicited comment by downed aircrew member on the ALS.

55. Mission commander interview, 2 May 1993.

56. Two of these were actually published. See GWAPS, Command and Control Volume, "Aardvarks Busting Bunkers" and "Strike Eagles on Call," Secret, draft, May 1993, 2-21 to 2-28 and 2-28 to 2-36.

57. *Tactical Analysis Bulletin* 91-2 (U), July 1991, deputy commander, Tactics and Test, 57th Fighter Weapons Wing, Nellis AFB, Nev., 1-5. Secret. The document goes on to say that the change processes was revised to smooth operations, it is not clear what these revisions were or what impact they had. This excerpt and reference are unclassified.

58. Ibid., 4–6.

59. Sir Michael Howard, "Military Science in an Age of Peace," in *Journal of the Royal United Services Institute for Joint Studies* 119 (March 1974): 2–5.
60. See Lt Col Mark A. Welsh, "Day of the Killer Scouts," *Air Force Magazine*, April 1993, 66–70.
61. Timothy T. Lupfer, "The Dynamics of Doctrine: The Changes in German Tactical Doctrine during the First World War," *Leavenworth Papers*, no. 4 (July 1981): viii.
62. Usually a read file or a slide for mass briefings.
63. This was clearly the case during the first ten days. Liaison between the Black Hole and unit commanders did improve throughout the war beginning with the collection of pilot video tapes. Colonel Deptula interview.
64. Notably, the F-111 wing at Taif and the F-15E wing at Al Kharj eventually sent experienced officers to fly on AWACS and JSTARS, respectively.
65. See Capt Dan Hampton, "Weasels at War," *Air Force Magazine*, July 1991, 56–59.
66. Mutually supporting plans were developed between these three missions.
67. Units are not given a "report card" during flag exercises, but exercise final reports highlight differences in performance and adaptation between week one and week two. They generally are significant.
68. Colonel Deptula interview.
69. Interview with former CENTAF deputy commander for Command, Control, Communications, and Computers, 14 May 1993.
70. Ibid.
71. Variance was substantial. Set-up time ranged from one week to four months.
72. Comments in *Tactical Analysis Bulletin 92-1*, (U) July 1991, deputy commander, Tactics and Test, 57th Fighter Weapons Wing, Nellis AFB, Nev., 2-5. Secret. Information extracted is unclassified. 2–5.
73. These data refer to secure communications at the squadron level.
74. Interview with former CENTAF deputy commander for Operations, 14 May 1993.
75. Logistical depth was stretched to the limit simply to provide for internal base communications. Interview with former CENTAF deputy commander for Command, Control, Communications, and Computers, 14 May 1993.
76. Interview with former CENTAF deputy commander for Operations.
77. Ultimately, this required erecting a series of microwave towers (delayed three months for political reasons) for communications between UAE, Bahrain, Qatar, and Saudi Arabia. See GWAPS, Command and Control Volume, 5–41.
78. Ibid., 5–39.
79. It is also notable that many units lacked a "unit telephone directory" until weeks before the war.
80. Generally, the squadron commander, intelligence, maintenance, mission planning cells, mission commanders, and in some cases logistics.
81. For example, see *4th TFW(P) Historical Contingency Reports*, January–March 1991 (U), Secret, USAF Historical Research Institute, Maxwell AFB, Ala. This reference is unclassified.
82. Interview with former CENTAF deputy commander for Command, Control, Communications, and Computers, 14 May 1993.
83. And also lower mission success rates.
84. Hallion, 196.
85. Indeed, this is the central dilemma in any forward-looking appraisal of the war.
86. Escort assets were said to have intervened on about 10 percent of all missions during the first ten days.
87. Here, the term logistical is used in its broadest sense to describe all human and material resources required for aircraft generation.
88. Colonel Deptula interview.
89. Ibid.
90. Many of these advantages are theoretical. For instance, aircraft substitutions between squadrons were not required.
91. Intermediate level support for the APR-47, in particular, was more easily obtained by pooling resources.

92. Along with a fairly advanced data communications capability.

93. This is the author's best assessment based on interviews with 561 TFS, 81 TFS operations personnel and the 35 TFW(P) commander, 15 June 1992.

94. Ibid.

95. Note: In the case of EF-111s, dispersal of assets would probably not have been possible without substantial costs in sortie generation capability. The case for dispersal is also less compelling because collocation with an F-111 wing permitted both face-to-face briefings for composite mutual support and advantages of increased logistical depth because of airframe commonalties.

96. Furthermore, logistical support in the F-15 community is widely regarded as a notch above that for most other platforms.

97. For instance, the 53rd TFS and 58th TFS.

98. Paid primarily in increased airlift requirements.

99. As one operations officer commented, "Even one MiG 21 in the middle of a package would have wrecked some havoc."

100. Proven Force Fully Mission Capable and Scheduling Effectiveness Rates were F-111E (75/100%), F-16 (87/99%), F-16 Wild Weasel (86/96%), F-4G (68/93%), EF-111 (69/100%), F-15C (77/100%). Briefing by Brig Gen Lee A. Downer, "JTF Proven Force," unpublished.

101. Including a large number of buildings, advanced communications infrastructure, hardened aircraft shelters, fuel distributions systems, and a munitions depot.

102. Notes from a trip report of Proven Force Logistics conducted on scene by a logistics officer deployed from Headquarters USAF, March 1991.

103. This reconstruction is based upon interviews with Lt Col Randy Mason, former CENTAF staff officer, May 1993 and Col Jim Crigger, former CENTAF deputy commander for Operations, May 1993. Essential background information was also obtained from two documents: William Youngblood, "USAF and Desert Strom: First Phase Deployment (7 Aug – 8 Nov)" (U), Office of Air Force History, draft, Secret; and Stephen B. Michael, "Operation Desert Storm and Chronology of the Deployment to the Persian Gulf" (U), Secret, May 1991. This reference is unclassified.

104. The plan was not supportable. It was dubbed by some logisticians as "the plan that couldn't close."

105. To an extent, all deployments require hand massaging. What made this process so difficult in this case was that automated planning and execution systems were not loaded with key deployment data, nor could they keep up with changes once data was loaded.

106. CENTAF provided the State Department with a number of basing alternatives to negotiate within the GCC. In several cases, the word came back that "basing had been approved" without referencing which permutations were approved. In one instance, this resulted in a unit actually landing without diplomatic clearance.

107. Readers interested in researching an optimum structure are referred to current CENTAF deployment plans.

108. Saturation of communications channels, saturation of air channels, failure of deployment automated systems, and overcrowding of air and naval ports, all left central authorities relatively helpless in shaping the logistical order of battle. See Maj Brad D. Lafferty, "Moving Air Force Logistics from a Mobilization Base to one of Mobility: Supporting the Global Reach Global Power Vision," thesis, School for Advanced Airpower Studies, June 1993, Maxwell AFB, Ala.

109. Comments in *Tactical Analysis Bulletin 91-2* (U), July 1991, deputy commander, Tactics and Test, 57th Fighter Weapons Wing, Nellis AFB, Nev., 1-6 and 1-7. Secret. Information extracted is unclassified.

110. Follow-on systems should be explored with the same creativity that revolutionized cockpit design by accounting for human factors.

111. Interview with former CENTAF deputy commander for Command, Control, Communications, and Computers.

112. Operations officer's comment, "One big problem was finding package commanders instead of some fungo."

113. Comments in *Tactical Analysis Bulletin 91-2* (U), July 1991, deputy commander, Tactics and Test, 57th Fighter Weapons Wing, Nellis AFB, Nev., 2-2. Secret. Information extracted is unclassified.

114. See *Jane's Radar and Electronic Warfare Systems*, 3d through 4th editions.

115. James P. Coyne. *Airpower in the Gulf* (Arlington, Va.: Air Force Association, 1990), 31.

116. The best deterrent is the capability to kill. The composite wings capabilities should be advertised.

117. Strategy is built not only of objectives but constraints. In a conventional context, the principal constraint that limits US national power projection is securing a lodgement in a foreign theater (i.e., an expeditionary capability). Without this, any contingency can become "an entirely new war." If the US can do this in a nonpermissive environment, a broad range of less-demanding capabilities are subsumed within this instrumental strategic objective.

118. For instance, two squadrons of F-4Gs might be mated with two wings of PGM-heavy platforms such as F-111s or F-15Es.

119. If this is too expensive, war plans should call for the temporary cannibalization of RTUs and depots. Furthermore, logistical depth can be buttressed by tactical airlift shuttles and dedicated logistical communications systems.

120. Air Force Manual 1-1, *Basic Aerospace Doctrine of the United States Air Force*, vol. 1 (Washington, D.C.: Department of the Air Force, March 1992), 1-1.

121. See Lafferty.

122. Some promising trends are developing (see note fourteen). See also Julie Bird, "McPeak Warns of Need to Retain Flexibility in Airpower," *Air Force Times*, 21 June 1993, 4.

Glossary

AAA	—	Antiaircraft Artillery
AAR	—	Air-to-Air Refueling
ACE	—	Airborne Command Element
ALG	—	Air Leadership Group
ALS	—	Air Leadership Survey
ATO	—	Air Tasking Order
AWACS	—	Airborne Warning and Control System
BDA	—	Battle Damage Assessment
CBO	—	Combined Bomber Offensive
CAFMS	—	Computer Aided Force Management System
CIJ	—	Close-in-Jamming
CCW(P)	—	Composite Combat Wing (Provisional)
CTAPS	—	Centralized (Tactical Air Control) Automated Planning System
C^3	—	Command, Control, Communications
C^4	—	Command, Control, Communications, and Computers
DCA	—	Defensive Counterair
EOB	—	Electronic Order of Battle
EMCON	—	Emissions Control
FDO	—	Fighter Duty Officer
FOL	—	Forward-Operating Location
GCC	—	Gulf Cooperation Council
GCI	—	Ground Control of Intercept
GWAPS	—	Gulf War Airpower Survey
HVAA	—	High Value Airborne Asset
IFF	—	Identification of Friend or Foe
JFACC	—	Joint Force Air Component Commander
LRC	—	Lesser Regional Contingency
MCM	—	Multi-Command Manual
MCO	—	Mission Coordination Orders
MRC	—	Major Regional Contingency
MAP	—	Master Attack Plan
MPC	—	Mission Planning Cell
MSS	—	Mission Support System
MTO	—	Mission Type Orders

OCA	—	Offensive Counterair
OPCON	—	Operational Control
PGM	—	Precision Guided Munition
ROE	—	Rules of Engagement
RTB	—	Return-to-Base
RTU	—	Retraining Units
SAM	—	Surface-to-Air Missile
SEAD	—	Suppression of Enemy Air Defenses
SOJ	—	Stand-off-Jamming
SMS	—	Southern Monolithic Structure
TACON	—	Tactical Control
TACC	—	Tactical Air Control Center
TFS	—	Tactical Fighter Squadron
TFW	—	Tactical Fighter Wing
TFW(P)	—	Tactical Fighter Wing (Provisional)
TLFE	—	Theater Large Force Employment Exercise
UAE	—	United Arab Emirates
WRSK	—	Wartime Readiness Spares Kit

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